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ABSTRACT

The purpose of this manual is to aid an educator in evaluating the Learning 100 (L100) system within his instructional setting. It includes information on the procedures necessary for evaluation, including planning for evaluation, stating objectives in operational terms, preparing a research design, administering the study, analyzing and interpreting the data acquired, reporting results, and translating the findings into curriculum improvements. Chapter 2 is a brief description of the Learning 100 system. Chapter 3 deals with the principles of designing evaluation and with methods for determining hypotheses to be tested, administering the study and imprementing the research findings in the curriculum. The appendixes include a listing of the overarching and subsystem objectives of the L100 system, a taxonomy of procedures for selection of data collection and instruments, a brief description of statistical tests, and suggestions for questionnaire items. There is a glossary and a bibliography. (PT)

Learning 100 Evaluation Manual

PRICE—$3.75

"Research is a high-hat word that scares a lot of people. It needn't. It is rather simple. Essentially, research is nothing but a state of mind—a friendly, welcoming attitude toward change—going out to look for change instead of waiting for it to come. Research, for practical men, is an effort to do things better and not to be caught asleep at the switch. It is the problem-solving mind as contrasted with the let-well-enough-alone mind. It is the 'tomorrow' mind instead of the 'yesterday' mind."

Charles F. Kettering
1876-1958

Learning 100 Evaluation Manual

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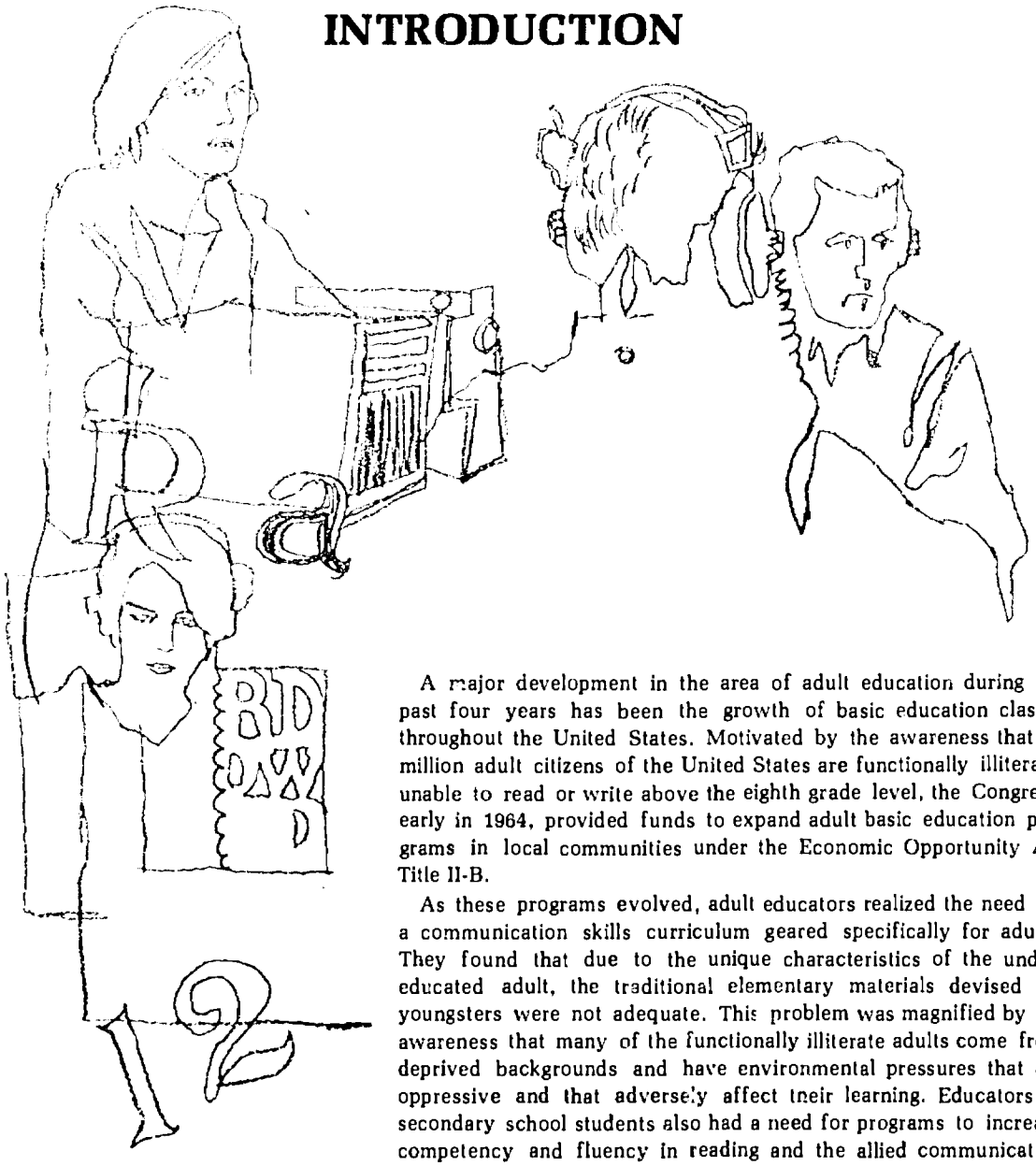
FOREWORD

This manual has been designed for use by teachers engaged in research for personal or professional reasons, for school principals interested in evaluating various aspects of the curriculum of their schools and for administrators, supervisors, and other school personnel interested in becoming involved in the research process. It may also be of value to individuals within a government agency or private industry interested in planning research with Adult Basic Education Programs that they are using or intend to use.

It has been written to serve both as a refresher for those familiar with educational research and as a guide for the neophyte researcher.

INTRODUCTION



A major development in the area of adult education during the past four years has been the growth of basic education classes throughout the United States. Motivated by the awareness that 25 million adult citizens of the United States are functionally illiterate, unable to read or write above the eighth grade level, the Congress, early in 1964, provided funds to expand adult basic education programs in local communities under the Economic Opportunity Act Title II-B.

As these programs evolved, adult educators realized the need for a communication skills curriculum geared specifically for adults. They found that due to the unique characteristics of the undereducated adult, the traditional elementary materials devised for youngsters were not adequate. This problem was magnified by the awareness that many of the functionally illiterate adults come from deprived backgrounds and have environmental pressures that are oppressive and that adversely affect their learning. Educators of secondary school students also had a need for programs to increase competency and fluency in reading and the allied communication skills, especially for the student from a disadvantaged environment or the potential dropout.

Various materials were developed by publishers to fill these curriculum needs. State or city agencies dealing with problems of basic education, federally funded projects attempting to raise the levels of the disadvantaged, private industries now involved with basic

and technical education for their employees, or secondary schools faced with the need to reinterest discouraged and frustrated teenagers or young adults who are potential dropouts are faced with a need to determine the effectiveness of these newly available educational programs.

To measure the success of a program, educators need to determine the changes they want to bring about in their students during a specific period of time, and these changes then become the objectives of the curriculum. The changes might include mastery of content, usually achieved in connection with the study of a particular subject, and the reactions of students to this content, including ways of thinking or acquisition of skills.

In addition, educators often wish to bring about changes in the affective domain. These changes include improving the self-concept, developing more resourcefulness, encouraging independence, raising levels of aspiration, and developing social living skills.

Once a set of objectives has been selected, evaluation is necessary to provide relevant information for curricular decisions and the means of sharing insights with others. It is an ongoing process of securing information to aid educators in deciding how well they are meeting their educational objectives and whether or not it is necessary to augment or to alter their curricula to meet their objectives. Intelligent decision making requires the selection of evaluation methods that will provide this necessary information.

Methods of evaluation include any means of securing valid evidence of attainment of objectives, such as paper-and-pencil tests, observations of behavior, and performance records. Evaluation, however, involves more than the methods themselves. It includes (1) clarification of objectives to the extent of describing which behaviors represent attainment in a particular area; (2) the development and use of various procedures for obtaining evidence of changes in students; (3) appropriate ways of summarizing and interpreting that evidence; and (4) the use of information gained to improve curriculum, teaching, and guidance.

The nature of an evaluation program depends on how each objective is defined and pursued. It also depends on the purposes for which the results of the evaluation are used. A school or educational program concerned only with mastery of information or attainment of a certain level of proficiency will confine its efforts to assessing that achievement in terms of local or national norms. If, on the other hand, the objectives include development of various attitudes and social behaviors, a broader range of evidence and special ways of appraising that evidence other than comparisons of test scores is needed. Evaluation conceived of in this manner is an integral part of curriculum innovation beginning with determination of objectives and ending with assessment of their attainment.

Caution needs to be exercised with any method of evaluation, however, for the information gained is only as valid and reliable as the procedures used in evaluation. Of particular importance in evaluation is the need to examine an instructional innovation in relation to a particular educator's objectives which are based upon the local conditions and needs. For this reason it is urged that the innovations be evaluated in the instructional settings in which they are being used.

The use of evaluation as a means of answering questions about the relative benefits of different curricula is of infinite value to the evaluator, the administrator, the teachers, the students and the community. When questions concerning benefit to students can be answered by research methods, valid decisions can be made about curriculum innovations.

PURPOSE

The purpose of this manual is to aid an educator in evaluating the Learning 100 (L-100) system within his instructional setting. The manual was designed to familiarize the prospective evaluator with the procedures necessary for evaluation, including planning for evaluation, stating objectives in operational terms, preparing a research design, administering the study, analyzing and interpreting the data acquired, reporting the results, and translating the findings into curriculum improvements.

METHODOLOGY

In order to fulfill the purpose for which this manual was developed, the information contained herein has been arranged in the following manner:

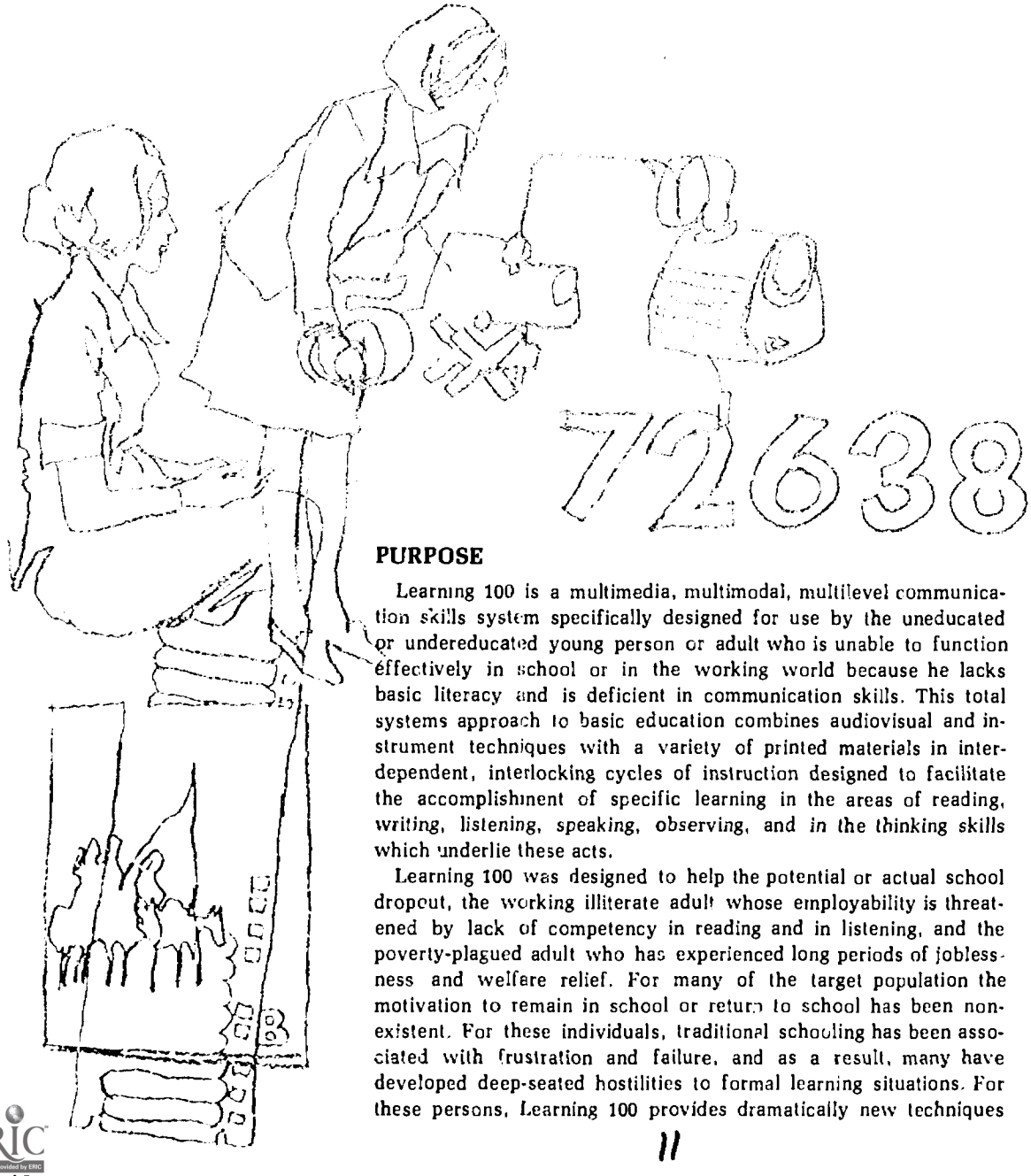
Chapter 2 is a brief description of the Learning 100 system. For a more comprehensive understanding of the purpose of the L-100 system and its implementation, it is recommended that the L-100 Instructor's Manual be studied and desirably one should visit a program in operation to observe the interaction between the students and the materials.

Chapter 3 deals with the principles of designing evaluation and centers first on the procedures to be followed in determining a research problem. The importance of reviewing related literature and asking relevant questions is emphasized. It is suggested that the educator's specific instructional objectives be examined in relation to the overarching and subsystem objectives of the L-100 system. (Overarching objectives are general, broad, and longitudinal in nature. Subsystem objectives, on the other hand, are more specific in nature and provide the plan of action for carrying out these

overarching objectives.) Chapter 3 also discusses methods for determining hypotheses to be tested, selecting research designs, selecting sample groups from a population, determining methods for collecting data to evaluate objectives, determining methods of analyzing data, preparing flow charts, administering the study, analyzing and interpreting the data, reporting the results, and implementing the research findings in the curriculum.

Appendix A is a listing of the overarching and subsystem objectives of the L-100 system and Appendix B includes a taxonomy of procedures for selection of data collection methods and instruments. A brief description of statistical tests appropriate for classroom or school district research which may serve as a guide for analyzing data is offered in Appendix C. Appendix D suggests sample questionnaire items which might be included in an evaluation study. To assist the person using the manual, a glossary of research and evaluation terms follows. A selected bibliography has been included. Finally, a graphic guide is included to aid the evaluator in relating the contents of this manual to his particular instructional situation.

LEARNING 100 — ADULT BASIC EDUCATION SYSTEM



PURPOSE

Learning 100 is a multimedia, multimodal, multilevel communication skills system specifically designed for use by the uneducated or undereducated young person or adult who is unable to function effectively in school or in the working world because he lacks basic literacy and is deficient in communication skills. This total systems approach to basic education combines audiovisual and instrument techniques with a variety of printed materials in interdependent, interlocking cycles of instruction designed to facilitate the accomplishment of specific learning in the areas of reading, writing, listening, speaking, observing, and in the thinking skills which underlie these acts.

Learning 100 was designed to help the potential or actual school dropout, the working illiterate adult whose employability is threatened by lack of competency in reading and in listening, and the poverty-plagued adult who has experienced long periods of joblessness and welfare relief. For many of the target population the motivation to remain in school or return to school has been nonexistent. For these individuals, traditional schooling has been associated with frustration and failure, and as a result, many have developed deep-seated hostilities to formal learning situations. For these persons, Learning 100 provides dramatically new techniques

and approaches through which they can achieve greater proficiency in the communication skills and thus utilize greater potential for social and economic adjustment.

KEY FEATURES

A *multimedia* laboratory approach is employed in order to initiate and maintain student interest and to provide the most efficient and effective medium for the presentation of each skill or concept. Because of the precision and control they afford, instrument techniques are used to provide instruction in perceptual and visual-functional skills, word recognition, and reading fluency. The inherent interest provided by the many audiovisual approaches employed creates a highly motivating and stimulating learning atmosphere.

Multimodal instruction is used to compensate for the relatively limited education of the undereducated, underachieving student. Some students learn more effectively through an aural-oral approach, some from a visual approach, some through kinesthetic activity, and others through an analytic approach. The use of a multimodal approach enables the student to capitalize on preferred learning styles and to develop greater proficiency in modalities in which he is less competent.

The *multilevel* organization of Learning 100 allows a student to enter at his level of need and to progress at his own rate. The system consists of a "readiness" stage for non-readers and six graded levels of instruction.

Non-readers enter the program at the RA level. Ten readiness sessions are devoted to building basic auditory and visual discrimination skills; eye-hand coordination; directionality; the ability to name, recognize, and copy numbers and the letters of the alphabet; the ability to pay attention and follow directions; a positive attitude toward learning; and other skills normally associated with the "readiness" period of reading instruction. A basic sight vocabulary of ninety words is established.

Students reading at the equivalent of first-, second-, or third-grade level enter the program at AA, BA, or CA respectively. At these levels, the major stress is on the acquisition of visual-functional and perceptual skills, and extensive sight vocabulary, independence in word attack through phonetic and structural analysis, and basic comprehension and study skills vital to both reading and listening.

Students reading at the equivalent of fourth- through sixth-grade level enter the program at levels DA, EA, or FA respectively. At these levels students are assumed to have developed adequate aural and visual perceptual skills and some independence in word

attack. More attention is devoted to enlarging the sight vocabulary, to enriching word knowledge through awareness of multiple meanings, and to developing analytical, critical, appreciative, and selective reading skills. In addition, instruction is provided in the advanced reading comprehension skills, listening-auding skills, and study skills needed for mastery of content area information.

Auto-instructional techniques increase both involvement and learning time for each student by permitting him to respond to every question and exercise, and by furnishing immediate reinforcement. Many of the materials and techniques are self-pacing so that each student can progress at a rate which is suitable for him.

Personalized instruction is possible because the instructor has many opportunities to work with individuals or small groups during times when the majority of students are involved in independent learning.

The *adult-oriented content* of Learning 100 was specifically developed to meet the needs and interests of the target population.

There are more than six hundred specially prepared reading and listening selections in three topic areas:

1. Adjustment to Everyday Living

These selections are designed to facilitate personal, social, and occupational adjustment. The majority are personal narratives, showing how various individuals met and coped with their problems.

2. Living in Today's World

The selections in this group were prepared to fill gaps in the student's educational background. Information in the areas of economics, arithmetic, social studies, and science helps to provide a foundation for the attainment of elementary and secondary school equivalency.

3. Enrichment Through Reading

Here the student finds that learning can be entertaining as well as informative. He reads or hears stories of adventure, suspense, and humor. He encounters some of the great literary classics, which add to his insight into human behavior and his understanding of the basic truths of life.

Cycles of instruction, which constitute the organizational pattern of the Learning 100 system, introduce and reinforce learning through a carefully planned sequence of activities. A cycle consists of four parts, each of which contributes to the development of specific skills, abilities, or concepts. Within each cycle, the student first receives perceptual accuracy and visual efficiency training. Next, he participates in activities which enrich his experiential background and prepare him for subsequent instruction. The third part of the cycle consists of a skill-building sequence which introduces and reinforces vocabulary, word recognition, and comprehension skills.

Finally, all the words, skills, and concepts taught during the skill-building sequence are applied by the student during independent reading activities in the fourth part of the instructional cycle.

PART I—PERCEPTUAL ACCURACY AND VISUAL EFFICIENCY (5—10 minutes)

Each cycle begins with a brisk five minutes of instrument training to develop high levels of accuracy and efficiency in the visual-functional and perceptual processes which initiate reading.

PART II—BUILDING EXPERIENCES (15—20 minutes)

A teacher-guided group discussion makes possible the establishment of a common experiential background which will serve as a framework for the instructional content to follow.

PART III—SKILL BUILDING (90 minutes)

Small groups of students move through a series of interrelated activities which assist them in the acquisition of new vocabulary, word attack skills, listening and reading comprehension capabilities and fluency in silent reading.

PART IV—APPLICATION AND ENRICHMENT (20—30 minutes)

The cycle culminates in a variety of activities in which the student applies the skills and vocabulary mastered during the skill-building segment.

Each instructional cycle can be completed in 2½ to 3 hours. The RA or Readiness Stage consists of ten cycles which can be completed in a minimum of 25 hours. Each subsequent level (AA through FA) consists of 30 cycles which require a minimum of 75 hours. Thus, if groups met five days a week for 2½ hours daily, any level beyond Readiness could be completed in 6 weeks.

It is recognized, however, that some students will require more time to master skills and concepts. For such students, additional reinforcement and a slower pace of instruction can be provided.

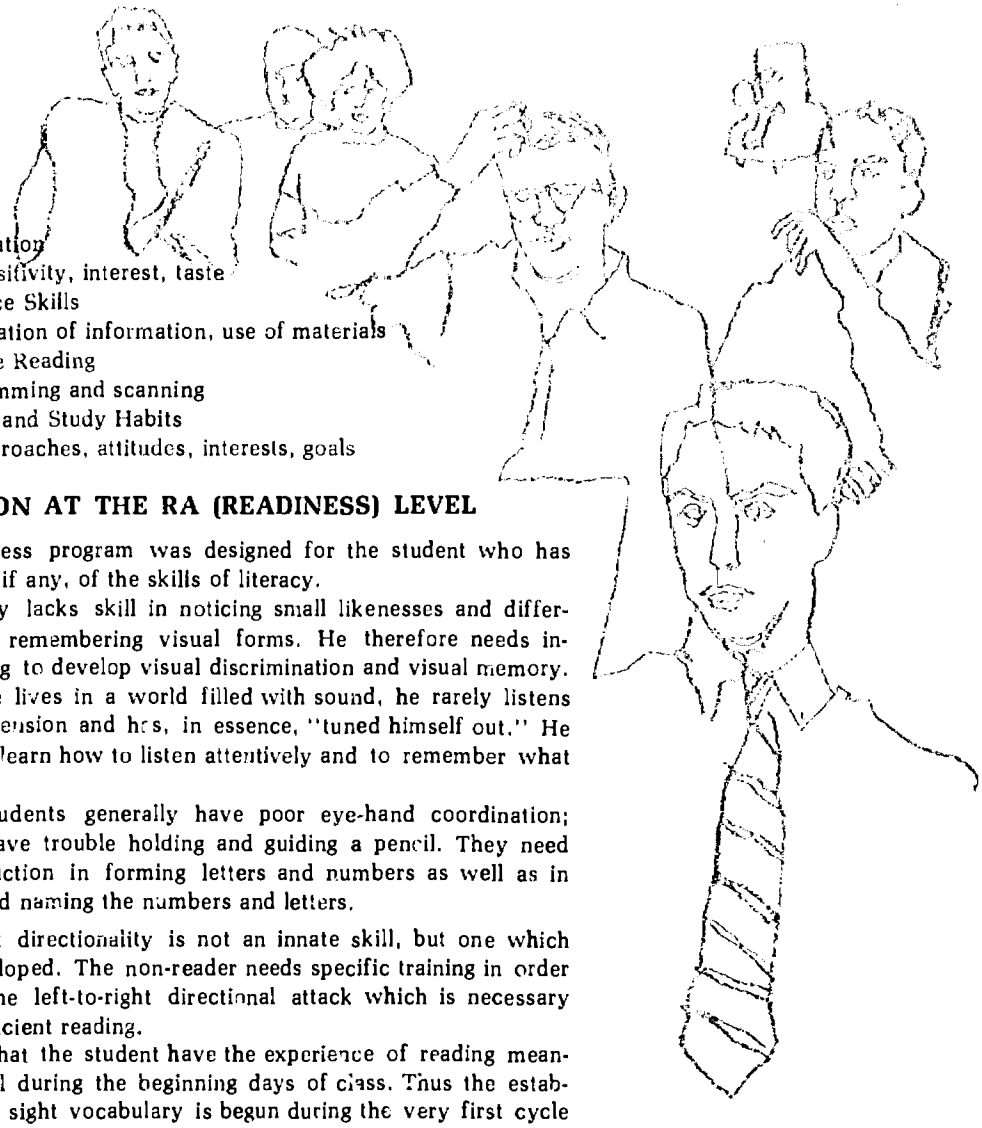
Continuous evaluation procedures are provided at frequent points during each cycle so that the instructor can quickly and easily identify those students who have mastered the skills and concepts necessary to continued progress and can detect those who need additional help before proceeding to the next segment of instruction.

Guidance for instructors is provided in the comprehension manual of procedures and detailed lesson plans which are an integral part of the system. These provide all of the background information and daily guidance needed to conduct Learning 100 classes. Explicit procedures coupled with the many auto-instructional activities make it possible for a teacher with little or no experience in reading instruction or basic adult education to administer a Learning 100 program successfully.

Comprehensive skill development is provided through instruction in a broad array of communication skills judged to be essential for successful functioning in a technological society. As a result of careful analysis of the processes and purposes of reading and listening, the twelve areas listed below were isolated for attention. In addition, provision is made for instruction in the allied communication skills of speaking and writing.

The program is unique in the specificity with which the various communication skills and subskills are developed. Because most undereducated students lack proficiency in basic perceptual and visual-functional skills, intensive instruction in these skills is provided, establishing a firm foundation for later instruction. The word recognition and comprehension skills developed at each level were selected on the basis of their importance to older students and are introduced in a developmental sequence.

1. Perceptual Accuracy
   Identification, recognition, retention
2. Visual Efficiency
   Binocular coordination, motility, directional attack
3. Word Knowledge
   Word meanings in context
4. Word Attack Skills
   Structural and phonetic analysis
5. Comprehension Fundamentals
   Recalling, understanding, associating
6. Interpretation
   Inferring, predicting, comparing, concluding, visualizing, sensing
7. Analytical Reading and Listening
   Form, structure, detail
8. Critical Reading and Listening
   Relevancy, accuracy, validity, significance



9. Appreciation
   Sensitivity, interest, taste
10. Reference Skills
    Location of information, use of materials
11. Selective Reading
    Skimming and scanning
12. Reading and Study Habits
    Approaches, attitudes, interests, goals

INSTRUCTION AT THE RA (READINESS) LEVEL

The Readiness program was designed for the student who has acquired few, if any, of the skills of literacy.

He generally lacks skill in noticing small likenesses and differences and in remembering visual forms. He therefore needs intensive training to develop visual discrimination and visual memory.

Although he lives in a world filled with sound, he rarely listens with comprehension and has, in essence, "tuned himself out." He thus needs to learn how to listen attentively and to remember what he hears.

Illiterate students generally have poor eye-hand coordination; many even have trouble holding and guiding a pencil. They need specific instruction in forming letters and numbers as well as in recognizing and naming the numbers and letters.

Left-to-right directionality is not an innate skill, but one which must be developed. The non-reader needs specific training in order to develop the left-to-right directional attack which is necessary for fluent, efficient reading.

It is vital that the student have the experience of reading meaningful material during the beginning days of class. Thus the establishment of a sight vocabulary is begun during the very first cycle of instruction, and the student soon finds that he can read simple stories with understanding and enjoyment.

INSTRUCTION AT LEVELS AA-CA (1-3)

The techniques and training procedures of Levels AA-CA build on the basic skills introduced and taught at the Readiness level.

Continued attention is devoted to the expansion of sight vocabulary. Beginning on the AA level and continuing through the CA level, particular emphasis is given to developing independence in word attack through phonetic and structural analysis. Upon completion of Level CA the student will have been sequentially introduced to an array of phonic and structural analysis skills which will enable him to independently unlock most of the words he will encounter in day-to-day reading.

Since context plays a role of prime importance in any activity involving the use of words, students receive intensive instruction in how to use context clues in unlocking the meaning of words and in understanding both oral and written material.

On Levels AA through CA, students are given instruction and practice in progressively more complex comprehension skills. The important skills of understanding main ideas and making inferences are introduced early in the AA level and reinforced in subsequent instruction.

Other interpretive skills such as visualizing, predicting outcomes, and determining cause and effect are developed sequentially throughout these levels.

It is also important that students become fluent and efficient readers. Beginning at the AA level and continuing through the CA level, several instrument techniques are used to develop skill in processing ideas and to build fluency in silent reading.

During these levels students also receive developmental instruction in those writing and speaking fundamentals which are practical and applicable to everyday living and working situations.

INSTRUCTION AT LEVELS DA-FA (4-6)

Students who enter Learning 100 at Level DA or above have as goals either entering the world of employment or completing elementary equivalency and continuing their education. Therefore, the program is broadened to include a wider variety of communication skills instruction that is directly related to the immediate needs of these individuals.

The instructional program at Levels DA-FA is organized into four parts, which require the same time intervals as the program at Levels RA-CA.

At these levels, continued emphasis, dictated by student needs, is placed on developing high levels of accuracy and efficiency in the visual-functional and perceptual processes. There is also continued emphasis given to the development of common experiential background and to the improvement of oral language facility.

On the fourth, fifth, and sixth reading levels of Learning 100, a combined recording and workbook approach is used to introduce and give practice in a variety of listening, reading, and writing skills.

At these levels, the Study Skills Library is used to help students develop the reading skills and approaches they need in order to read effectively in the content areas. Lessons programmed for independent learning provide step-by-step instruction in the areas of interpretation, evaluation, organization, and reference.

During each cycle at these levels, students participate in teacher-guided activities designed to refine their ability to use context and

to improve their spelling ability. Independent activities are provided which stress dictionary usage.

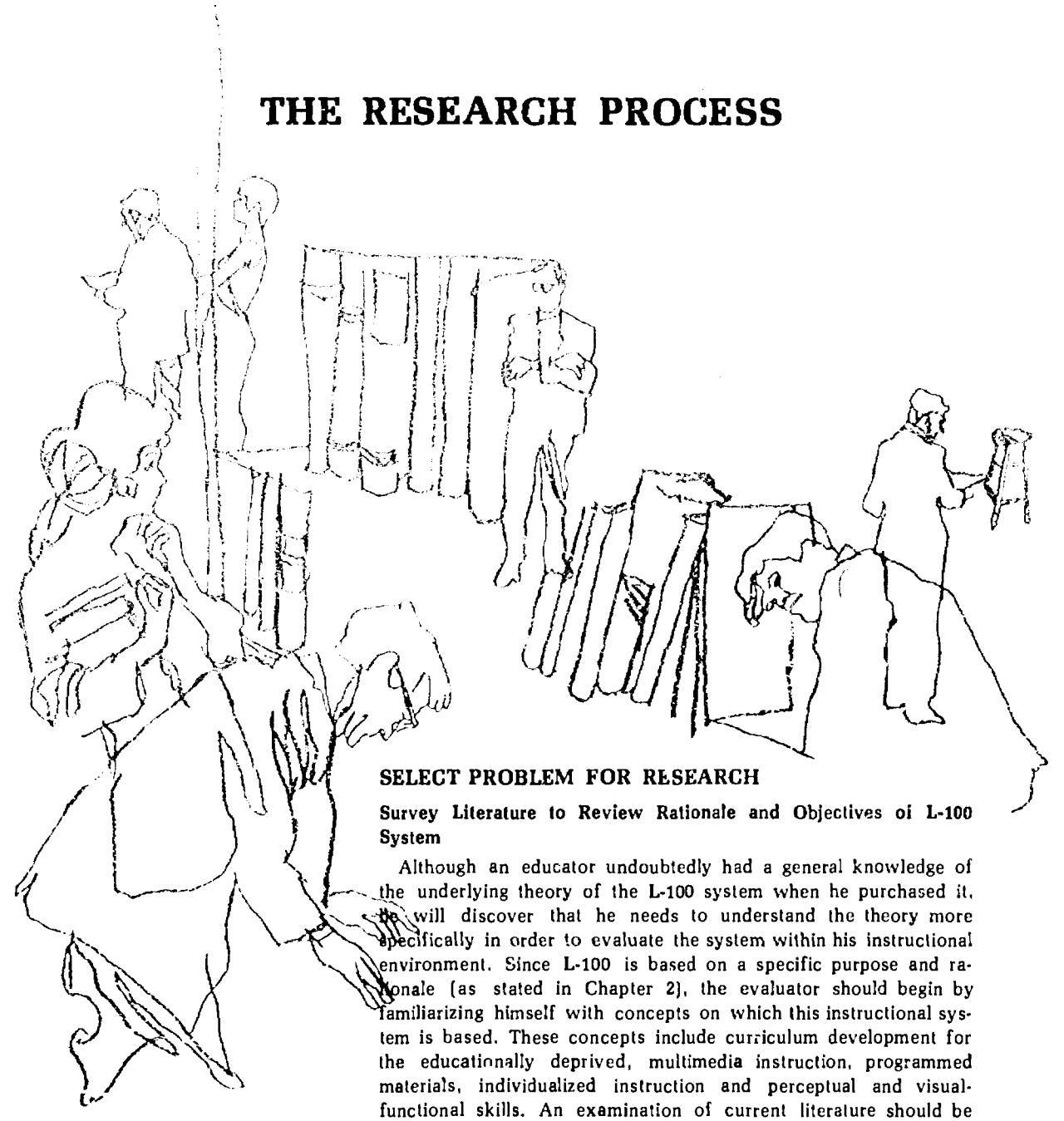
As on the lower levels, continued stress is placed on developing fluent, efficient reading and improving the comprehension skills.

LEARNING LABORATORY

In essence, Learning 100 converts the classroom into a learning laboratory in which each student is encouraged to assume responsibility for his own daily activities and the progress he will make. The program is arranged so that the student is exposed to a variety of independent, small-group, and teacher-directed activities. Students move from one learning activity to another, completing prescribed cycles of instruction in an orderly, sequential manner.

The carefully structured program of skill development places success within reach of students who have a history of repeated failure, and whose socioeconomic background has rendered them unable to cope with traditional curriculum.

THE RESEARCH PROCESS



SELECT PROBLEM FOR RESEARCH

Survey Literature to Review Rationale and Objectives of L-100 System

Although an educator undoubtedly had a general knowledge of the underlying theory of the L-100 system when he purchased it, he will discover that he needs to understand the theory more specifically in order to evaluate the system within his instructional environment. Since L-100 is based on a specific purpose and rationale (as stated in Chapter 2), the evaluator should begin by familiarizing himself with concepts on which this instructional system is based. These concepts include curriculum development for the educationally deprived, multimedia instruction, programmed materials, individualized instruction and perceptual and visual-functional skills. An examination of current literature should be reviewed at this time. Selected references can be found in the bibliography of this manual.

Examine Learning 100 System Materials and Procedures

Next, it is vital that one become thoroughly familiar with the nature of the system itself. This can best be facilitated by first

reading the Instructor's Manual, second, by reading and listening to and looking at selected lessons from various levels of the program and, lastly, by observing the system in action or by actually using the system with a group of students.

The evaluation process grows out of the relationship between an educator's objectives and the instructional objectives of the educational program. The educator, for example, may decide that a major objective of his program is to keep students motivated so that they attend classes. An additional objective may be that students be able to complete an eighth-grade or high school equivalency examination. Passing such an examination is vital for the success of his program.

Naturally an educator is primarily concerned with the extent to which the educational program fulfills his particular objectives. However, his objectives must be written operationally for a research project in terms of specific demonstration of achievement or performance. Objectives stated in terms of performance communicate explicitly the kind of behavior the learner must exhibit as evidence that he has achieved the objective, the conditions under which this behavior is expected to occur, and the level of performance considered acceptable as evidence that the learning has taken place.

To assist in planning an evaluation program, the objectives of L-100 are listed in Appendix A so that an educator may examine them in relation to his curricular objectives. The educator should compare his broad objectives with the L-100 overarching objectives, and then review the subsystem objectives which are written operationally selecting those which he wants to use as a basis for his research project. One must be cautious, however, when selecting operational objectives for a study. In evaluating an instructional program, the educator must be certain that he isolates the objectives which he wants to examine, holding all factors constant in his evaluation except those which he plans to evaluate. In evaluating two instructional programs, for example, L-100 and another set of instructional materials, one must be certain that all factors in the study other than the two instructional programs remain constant.

FORMULATE RESEARCH QUESTIONS

After the concepts, materials, and procedures of the L-100 system have been carefully examined and the educator's general instructional objectives determined and compared to the objectives of the system, the next step would be to formulate questions based on an understanding of the theory and application of L-100 and a knowledge of the particular setting in which L-100 is being used.

Such questions might include:

1. Will a systems approach be beneficial within my instructional environment?
   a. What will be the comparative gain of students using a systems approach compared to students using a conventional approach?
   b. Will students react more favorably to the systems approach than to a conventional approach?
2. Will a multimedia system provide for an increase in student motivation and learning?
   a. To what extent do the multimedia techniques influence the attendance patterns of adults or young adults?
   b. Will exposure to a multimedia system encourage greater classroom interaction?
3. Will L-100, an individualized learning system, provide students with an efficient learning experience?
   a. Will students using Learning 100, an individualized learning system, make greater gains than those using a less individualized approach?
   b. In terms of age, day or evening students, urban or rural settings, what groups will demonstrate greater gains in reading achievement?
4. What will be the reactions of teachers who use the Learning 100 system in their classrooms?

Formulating questions is not an easy process. If a question is to be useful for evaluation, it must be answerable by available means of observation or experimentation in the existing environment. The question should also make clear the nature of the observations that have to be made in order to find an answer. Often there is a tendency to ask questions which cannot be answered readily by evaluation. For example, one might ask the question, "What effect does exposure to the Learning 100 system have on the self-concept of the students?" This type of information is valuable but it is more difficult to measure objectively with available instruments. The teacher may observe an improvement in the self-concept of her students but attributing it to the use of the instructional system is often difficult to prove. However, every attempt should be made to ascertain what changes occur in the affective domain.

After an educator has decided what questions he will explore, these questions become the basis for formulating hypotheses. A hypothesis is a tentative assumption or a statement of the problem or problems of the study in testable terms. It may be stated either as a null hypothesis, the "hypothesis of no difference," or as a research hypothesis which can be accepted if the null hypothesis can be rejected.

The null hypothesis is expressed when the purpose of the study is to determine whether or not a difference exists between groups. A statistical test is employed which will enable the educator to determine if the differences between the groups are significant or if they can be attributed to chance. The research hypothesis, however, is a statement of expected outcomes based on theory or previous research. It suggests that in a certain specified situation a particular outcome would be expected. The hypothesis states the outcome and suggests the kind of experiment that might be designed to test the hypothesis.

For example, an evaluator looking at some of the questions mentioned previously might develop certain hypotheses for evaluation. Stated in the null form, example hypotheses might be: "There will be no difference between standard scores on the *Stanford Achievement Test* earned by experimental (L-100) and control (conventional program) group students." "There will be no difference in the frequency of attendance of students using Learning 100 and students using a conventional reading program." "There will be no difference in the reactions toward instructional materials by experimental group teachers using L-100 and the control group teachers using traditional materials, as determined by a teacher questionnaire."

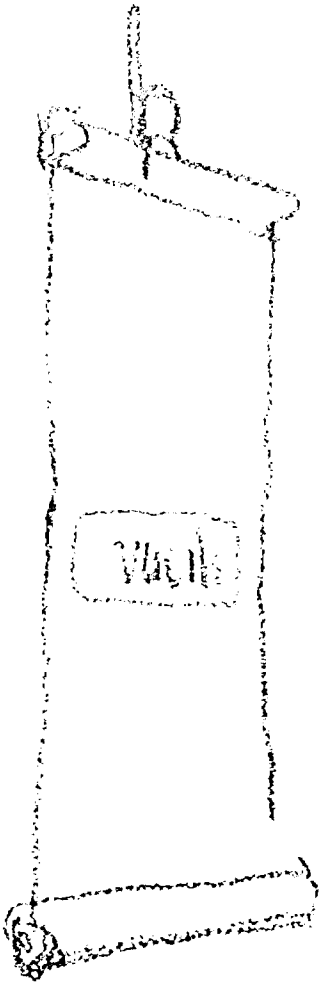
The corresponding research hypotheses might be: "Scores earned (on the *Stanford Achievement Test*) by the experimental group using L-100 will be higher than scores earned by the control group using a conventional program." "The frequency of attendance for students using Learning 100 will be higher than for students using a conventional reading program as determined by attendance records." "Teachers using L-100 will react more favorably toward L-100 materials than will control group teachers toward conventional materials, as determined by a teacher questionnaire."

It is important for an evaluator to develop a hypothesis which is suitable for experimentation. In *A Guide to Educational Research*, Robert M. W. Travers has suggested the following characteristics of good hypotheses:

1. They should be rooted in a framework of theory or previous research.
2. They should be testable. One reason why hypotheses may be untestable is the possibility that one or more variables cannot be measured for some reason. Another general source of untestable hypotheses are areas where little or no organized knowledge exists on which to formulate clear and testable hypotheses.
3. They should state relationships between variables.

4. They should be limited in scope. It is better to get a clearly defined corner of the universe in your hypothesis than to try something of global significance which may in reality require a lifetime of work.
5. They should be consistent with most known facts.
6. They should be stated, as far as possible, in simple terms. Simplicity can increase clarity at no loss of significance. One aspect of simplicity is avoiding vague terminology.
7. Finally, hypotheses should be amenable to testing in a reasonable length of time. (Cook, editor, pages 181-182)

Good hypotheses are based on asking good research questions. However, not all problems can be stated in the form of a hypothesis. For example, in a descriptive survey where one is describing an existing situation, there would be neither a statement of expected outcomes as in a research hypothesis, nor any statistical test of differences between groups. In a descriptive survey one might formulate a question such as, "What are the various means of grouping employed by teachers using L-100 in the classroom?" A study of this type could serve as background for a future experimental study by suggesting areas where more formal research is desirable.



PREPARE RESEARCH DESIGN

Having stated a hypothesis or hypotheses, the educator then develops a specific research design. A design is a method for controlling the variables during the course of an experiment. Although many types of designs may be developed, three types are of particular relevance to the educator as he attempts to evaluate instructional materials.

The first is the "new program versus the traditional." This type may be employed to seek information regarding the effectiveness of one program or system over another. Information gained would serve as a basis for determining whether more materials of a particular type should be purchased and for determining groups for which the materials are most successful.

The second type is the "program A versus adaptation of program A" design. An educator faced with scheduling problems at his school because of an increasing student population may wish to experiment with several variations in scheduling to determine how he can best adapt the system to suit his needs. He would then compare the achievement test scores of the two or three groups to determine the effect of the variation on the progress of each group. An educator may wish to determine the effect of scheduling the lessons in one continuous block of time contrasted to the same amount of time spread over two days.

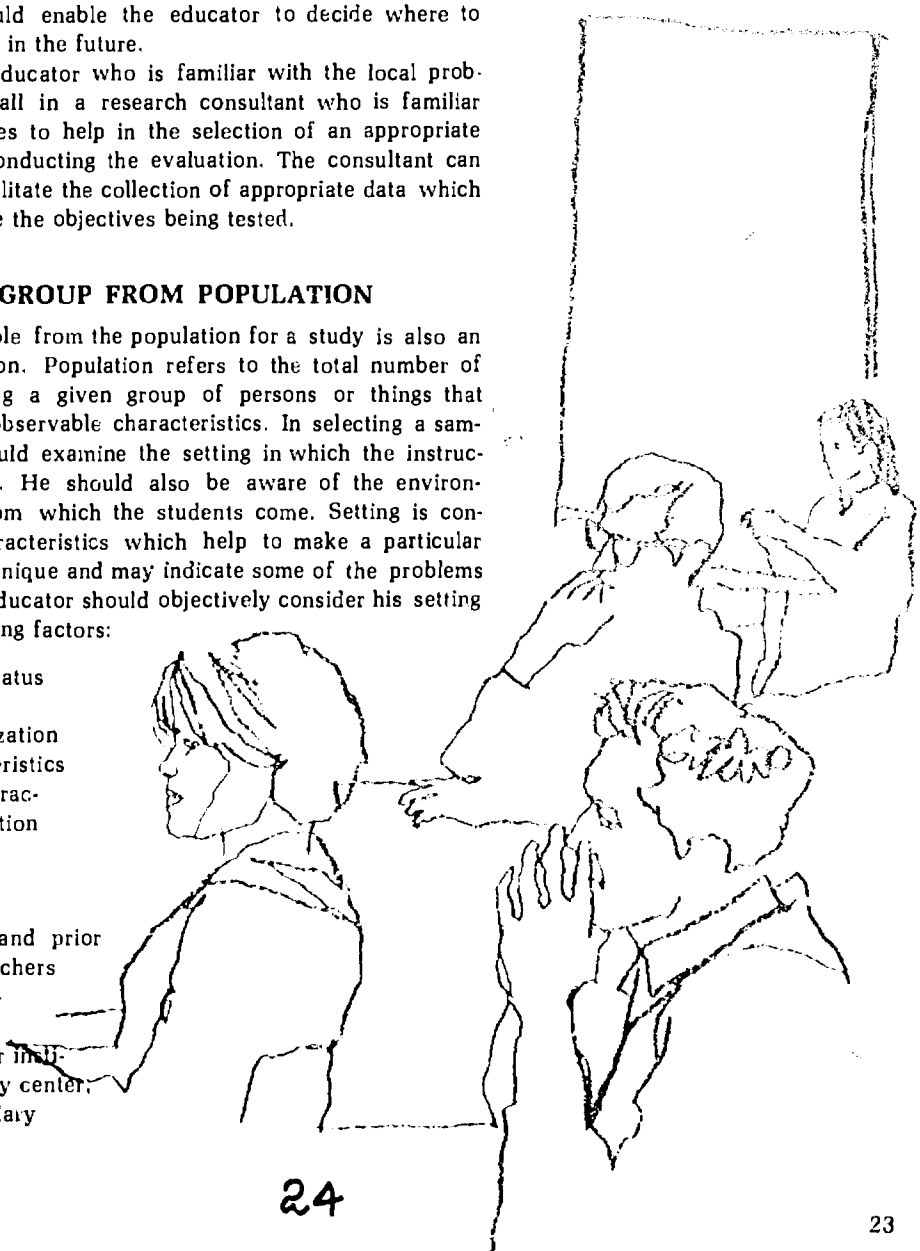
The third type of design is "program A versus program A under different conditions." With this design, the educator might want to determine whether the system is more effective with one particular group of junior high or senior high students than with another. Both groups of students would be exposed to L-100 under similar conditions. The outcome of this type of study would provide information which would enable the educator to decide where to concentrate his efforts in the future.

At this point, an educator who is familiar with the local problems may wish to call in a research consultant who is familiar with research practices to help in the selection of an appropriate plan of action for conducting the evaluation. The consultant can offer guidance to facilitate the collection of appropriate data which will be used to analyze the objectives being tested.

SELECT SAMPLE GROUP FROM POPULATION

Selection of a sample from the population for a study is also an important consideration. Population refers to the total number of individuals constituting a given group of persons or things that have some common observable characteristics. In selecting a sample, the educator should examine the setting in which the instructional program exists. He should also be aware of the environmental conditions from which the students come. Setting is concerned with the characteristics which help to make a particular school or institution unique and may indicate some of the problems inherent in each. An educator should objectively consider his setting in terms of the following factors:

1. Socioeconomic status
2. Regionalism
3. Degree of urbanization
4. Physical characteristics
5. Philosophical characteristics — innovation oriented
6. Size of district
7. Size of classes
8. The education and prior experience of teachers (certified or paraprofessional)
9. Type of school or institution (community center, job corps, secondary school)



The characteristics of the students in a Learning 100 class, adult or secondary, need to be considered when selecting a sample for study. The following are some of the factors which may be examined:

1. Age
2. Sex
3. Race
4. Language spoken at home
5. Years of formal schooling
6. Geographic area where majority of schooling was obtained
7. Previous school achievement
8. Scholastic aptitude test scores (if available)
9. Attendance record
10. Year of most recent employment (ABE only)

Conditions within classrooms also need to be as similar as possible. Some of the questions which the investigator should ask in considering experimental and control classes to be used in the study are:

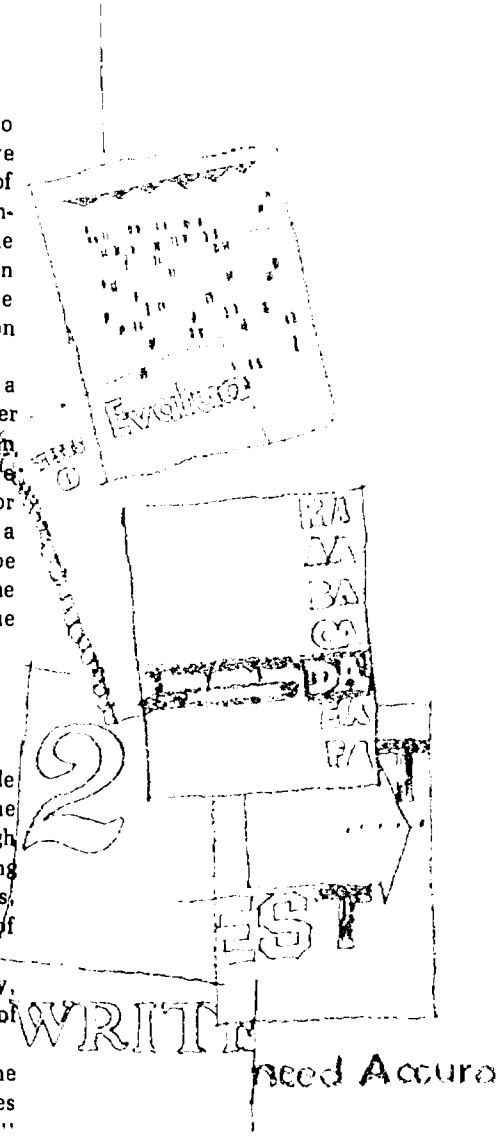
1. What time of day do the classes meet?
2. Do the classes meet for the same length of time each day?
3. How much time is devoted to reading instruction and/or communication skills instruction?
4. Are the classes taught by certified teachers, para-professionals or others?
5. What are the background characteristics of the teachers which may have some effect on the students within the classes, i.e., length of service, educational level, and experience with grouping?
6. How much training have the teachers received in the use of the instructional materials being employed in the study?
7. Is out-of-class preparation time provided for the teachers?

When selecting a sample for the study, the evaluator may decide to use an intact class of students, such as a classroom group within a secondary school. When this is the case, the evaluator may wish to locate another similar class within the same school district or area which can serve as a control class; or he may want to use data compiled in other years for previous classes, at the same grade level and with the same teacher, as a control. However, in selecting a sample of intact classes, subtle bias or additional variables often are introduced. Therefore, the researcher must try to isolate in advance as many of the variables as possible and small initial differences between experimental and control groups can be statistically adjusted.

Random selection of a sample will eliminate or "neutralize" some of the differences which would occur within intact groups. If the total population were grouped together and some students

were randomly assigned to the experimental class and the rest to each of the control classes, the researcher could confidently believe he had eliminated systematic bias and had reduced the effects of individual variations. The theory underlying random sampling implies that the larger the sample, the less bias exists. Thus, if the sample is large enough, one would expect to find in the population about the same number of low-ability students, about the same proportion of males and females, and about the same proportion of persons of a given age.

Another similar technique which can be used in selecting a sample is called blocking. Similar students are grouped together and the students in this group are then randomly assigned to an experimental or control class. For example, if all males were grouped together and then randomly assigned to one group or another, one could later evaluate the effects of the system on a similarly assigned group of females. This procedure could then be repeated with an age range as a variable so that in comparing the experimental and control groups for each subgroup, differences due to sex and age will have been eliminated.



DETERMINE METHODS FOR COLLECTING DATA TO EVALUATE OBJECTIVES

The next step in developing the research design is to decide what types of evaluation instruments to use to collect data for the research project. Many evaluation techniques are available although some of these are less well known. To assist you in choosing appropriate evaluation techniques from the many available ones, Appendix B of this manual presents a taxonomy showing types of techniques that may be used for evaluation.

In considering the sample research hypotheses stated previously, one finds that these hypotheses can be evaluated in a number of ways other than those indicated below.

1. "Scores earned (on the *Stanford Achievement Test*) by the experimental group using L-100 will be higher than scores earned by the control group using a conventional program."
2. "The rate of attendance for students using L-100 will be higher than for students using a conventional reading program as determined by attendance records."
3. "Teachers using L-100 will react more favorably toward L-100 materials than will control group teachers toward traditional materials, as determined by a teacher questionnaire."

Although standardized tests, teacher questionnaires, and use of teachers' logs are valid techniques commonly employed, other techniques may also be suitable. Local or teacher-made tests may be utilized rather than standardized tests as a measure of gains.

Observational techniques may take the place of or be used in adjunct with teacher questionnaires. As an indication of motivation, teacher anecdotal records may be used as well as attendance records.

The evaluator must consider his objectives and the objectives of the instructional program when selecting the evaluation instrument to be used. A standardized test which does not reflect what is being taught to the students is of little value. Similarly, a teacher questionnaire which does not ask questions pertinent to the objectives of the evaluation is merely a waste of time.

For the evaluator concerned with adult basic education, suitability of tests for adult basic education classes is a problem. In many cases, evaluators have had to rely on standardized achievement tests developed for children. Some, therefore, have established their own norms for the tests using their own population or similar populations as a basis or they have adapted available tests for local use. Recently, however, tests designed for use by adults have been marketed. One may refer to sources such as those included on page 61 of the bibliography to gain the most up-to-date information on various tests.

If a researcher decides to use subjective evaluations such as a questionnaire or teacher observation techniques, he may find that he will need assistance in preparing the instruments. References are included in the bibliography and samples of questions for a questionnaire can be found in the Appendix.

Another concern when determining methods for collecting data is that the evaluator consider all data that might be necessary for his study. It is not mandatory that he use all the data he collects but if he has neglected to gather some vital information his study may not be as complete as he had hoped. For example, an evaluator may decide that he wants to keep a record of why students drop out of L-100 to ascertain whether it is related to the instructional program or to personal factors.

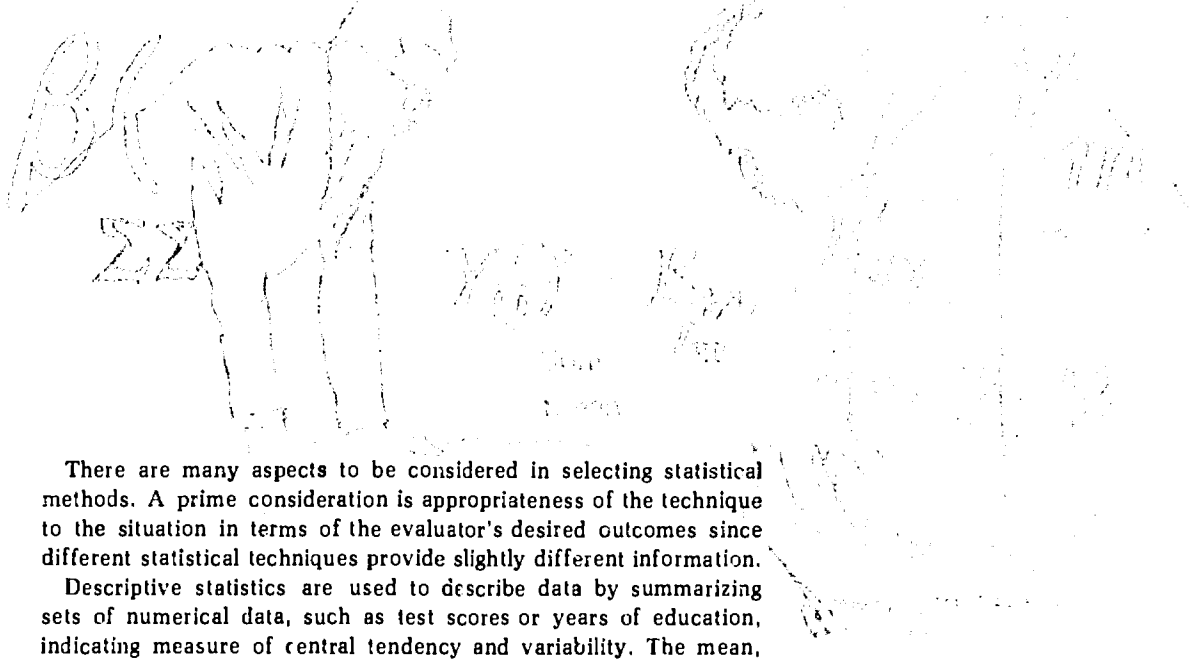
He may also wish to consider attendance as well as dropout rate. If students attend only half of the class sessions, their exposure to the materials would certainly be limited. This could be a contaminating factor in the research study and should, therefore, be part of the record.

The evaluator may also be concerned with what happens during the class periods. For this purpose he might ask the instructors to keep logs or anecdotal records of their daily classroom activities as well as records of daily progress by students and their reactions to the materials. In addition to the daily progress reports of instrument speeds during the various forms of training as the student progresses through the cycles, the teacher may wish to keep an accounting of the number of supplementary books each student

reads and book reports and other papers completed. From these daily records, the evaluator might extract information that would aid him in the analysis of how students progress through the program.

DETERMINE METHOD OF ANALYZING DATA

For an evaluator to determine whether the hypotheses of his study should be accepted or rejected, it is necessary that he employ a method to analyze the data. Analysis of data includes a comparison of the outcomes of the various instructional approaches used with the groups being examined and the making of a decision as to the achievement of the goals of the research. One of the more common methods of analysis used for evaluation is statistics. Statistics are numerical facts, but statistics is also a body of methods to aid in making decisions when dealing with only a sample of the entire population over a relatively brief period of time.



There are many aspects to be considered in selecting statistical methods. A prime consideration is appropriateness of the technique to the situation in terms of the evaluator's desired outcomes since different statistical techniques provide slightly different information.

Descriptive statistics are used to describe data by summarizing sets of numerical data, such as test scores or years of education, indicating measure of central tendency and variability. The mean, or arithmetic average is the most commonly used measure of central tendency. This indicates where the scores appear to center or group together on the scale used. Measures of variability reflect the spread in a set of scores.

Inferential statistics concerns itself with the relationship between variables and the inferences that can be drawn from the observed small sample to a larger population. Statistical techniques can be

utilized to determine the degree of confidence that can be placed in inferences about such sample relationships. A statistical test attempts to determine the probability that chance alone underlies an observed relationship, for instance that test score is related to reading approach.

Specific statistics are used depending on the type of scale of measurement one obtains by the quantification process. Quantification is the process of assigning numerical value to data that normally would be qualitative. Data are quantified in four basic ways, commonly referred to as the nominal, ordinal, interval, and ratio scales. For explanations of these scales, refer to the glossary of this manual.

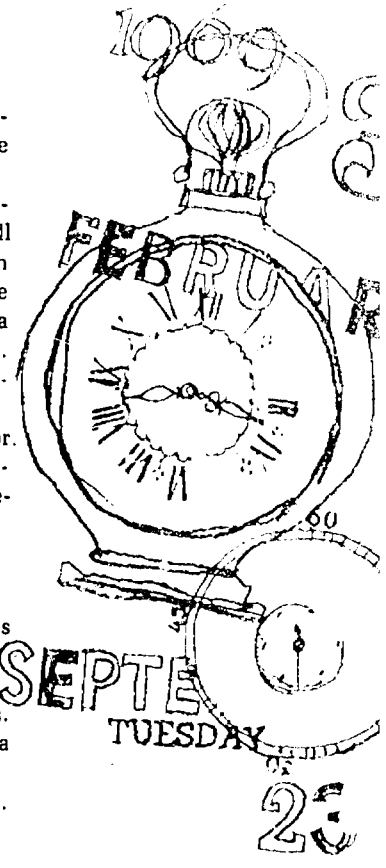
Research in education usually makes use of the nominal, ordinal, and interval scales while the ratio scale is used primarily in the physical sciences. Two general types of statistics may be used to analyze data measured by these scales. Non-parametric tests, statistical tests that do not depend upon the assumption of normality in the distribution of sample or population scores, are most useful with the first two types of measurements and, to some extent, with the third. Parametric tests, statistical tests based on the assumption that the scores were drawn from a normally distributed population, are most useful with the interval scale level of measurements. (Parametrics are less useful with ordinal and nominal scales.)

The decision as to which statistical technique to use may not be one which the evaluator can make on his own unless he is familiar with statistical methods. He may wish to review Appendix C, Outline of Statistical Tests, which briefly describes some of the statistical techniques available to the educator-evaluator. In addition, he may wish to consult with statisticians and experts in the area of educational measurement in order to be able to select an appropriate technique with which he can work comfortably.

There are many books of varying degrees of complexity dealing with statistical analysis, references to some of which are in the bibliography of this manual. Skimming through several books may serve to refresh the thinking of the evaluator who has had prior experience with statistics. And, for the inexperienced researcher, they may be able to provide background information and definitions which will enable him to deal more adequately with the assistance a statistical consultant can provide.

PREPARE FLOW CHART

After determining the objectives of the study, the sample, and the instruments to be used for evaluation, the next step is to develop a realistic timetable. A flow chart, such as the example on page 30, outlines all the procedures which must be undertaken in a study and the time by which each procedure must be completed if the ensuing activities are to be carried out within a specified time.



Whenever any one of the activities listed on the chart is not completed on time, each of the subsequent activities will probably be delayed.

By preparing a flow chart of research activities, the educator-investigator can plan schedules so that students and teachers will be interrupted as little as possible. This procedure also aids in determining the cost of a research project. If one realizes that the data must be computed at a particular stage which falls within a specific budgetary period, the costs can be provided for in advance. Also, by charting activities one can work around scheduled holidays and other known alterations in the regular schedule.

If a flow chart is prepared carefully and includes all the major steps necessary for evaluation, it can be revised should any unexpected problems arise and still retain the continuity of the research plan. Problems such as the following might arise:

1. A serious epidemic may occur.
2. Weather conditions may be unusually bad.
3. Teachers scheduled to teach may not fulfill their obligations for various reasons.
4. Budgetary provisions may be lowered suddenly.
5. A fire or other emergency may destroy the teaching facilities.
6. The person in charge may neglect to administer tests at a particular time.
7. Research consultants may not be available at a specified time.
8. Delays may occur because of mail problems.
9. Computer time may not be available when desired.

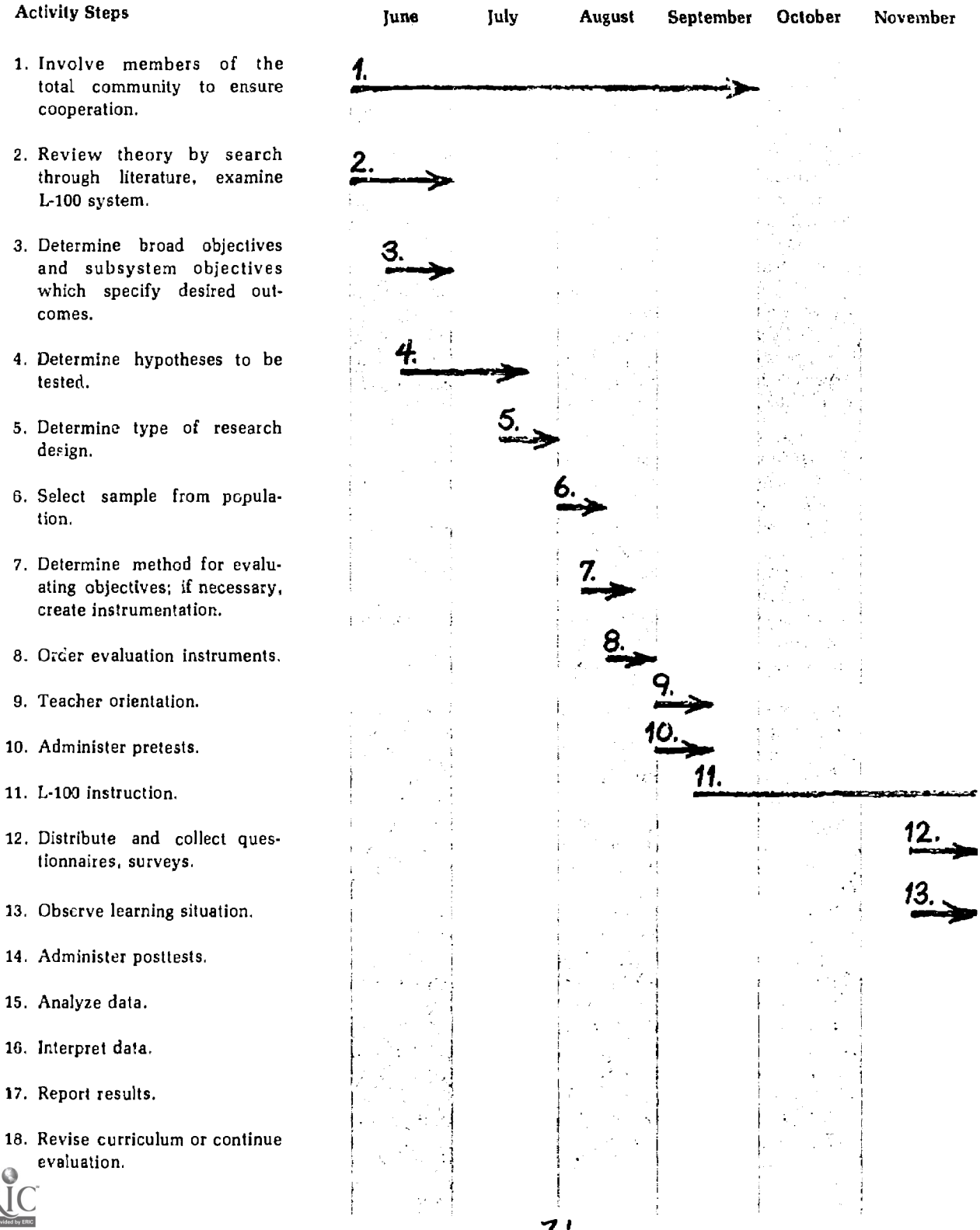
Any one of these problems could force the evaluator to make alternate provisions for the research project. Naturally, he would want to salvage as much of the research as possible. This is one reason it is important to forsee potential problems and be prepared for alternate actions.

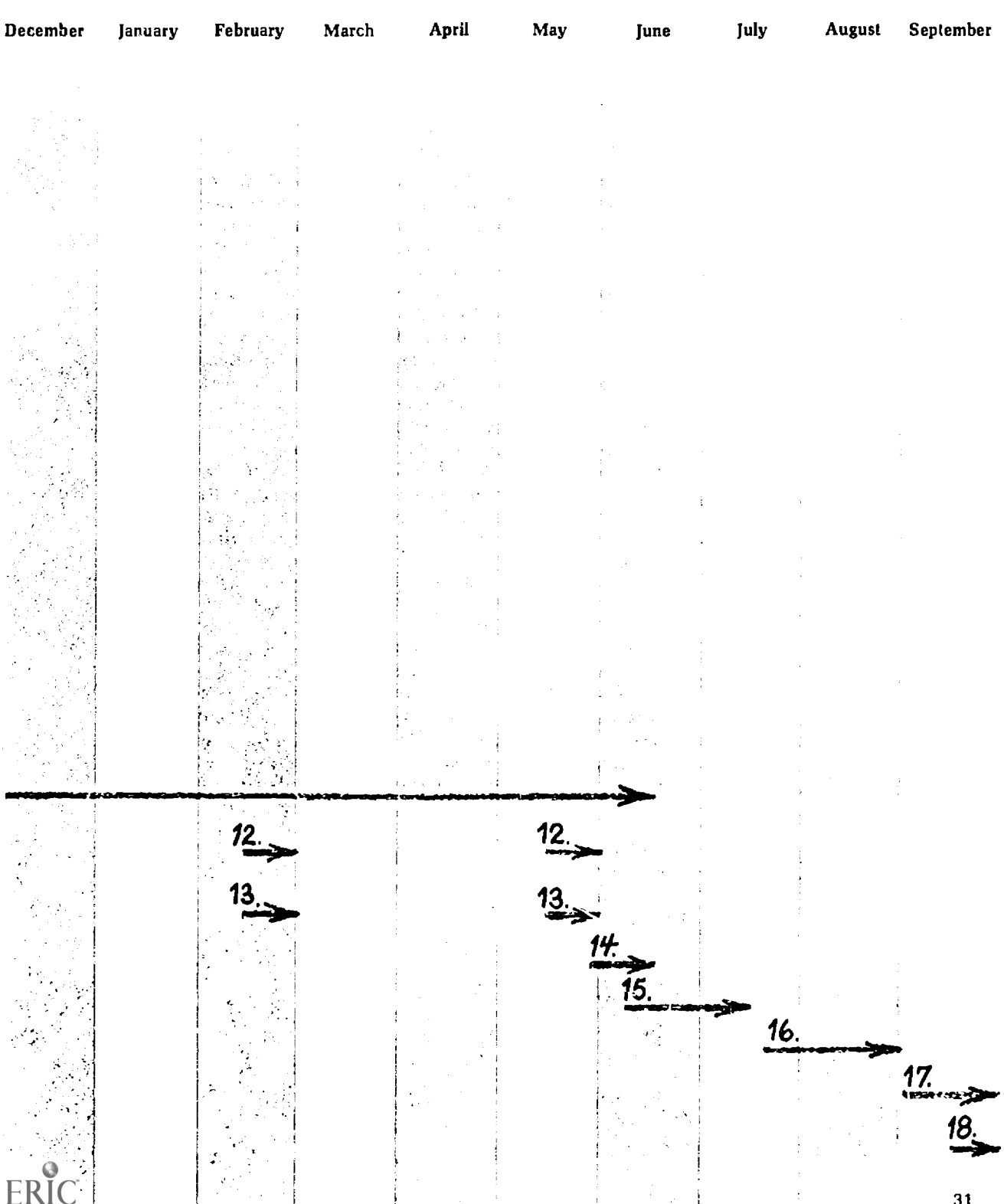
The evaluator may find, for example, that the time specified for teacher interviews is not feasible because there is a flu epidemic in the community. After serious consideration, the evaluator may decide that he will alter the design and have teacher interviews at a later date. At the same time, he should realize that the information may be different. For example, teachers may respond differently after working with L-100 for a period of time. However, the data can still provide valuable feedback if the change is taken into consideration.

If alternate provisions are to be made, however, the evaluator should examine his flow chart carefully and revise his timetable so that adequate time is allowed for each subsequent stage in the research.

The accompanying flow chart shows the schedule of activities for a sample L-100 research project.

FLOW CHART OF A SAMPLE RESEARCH PROJECT

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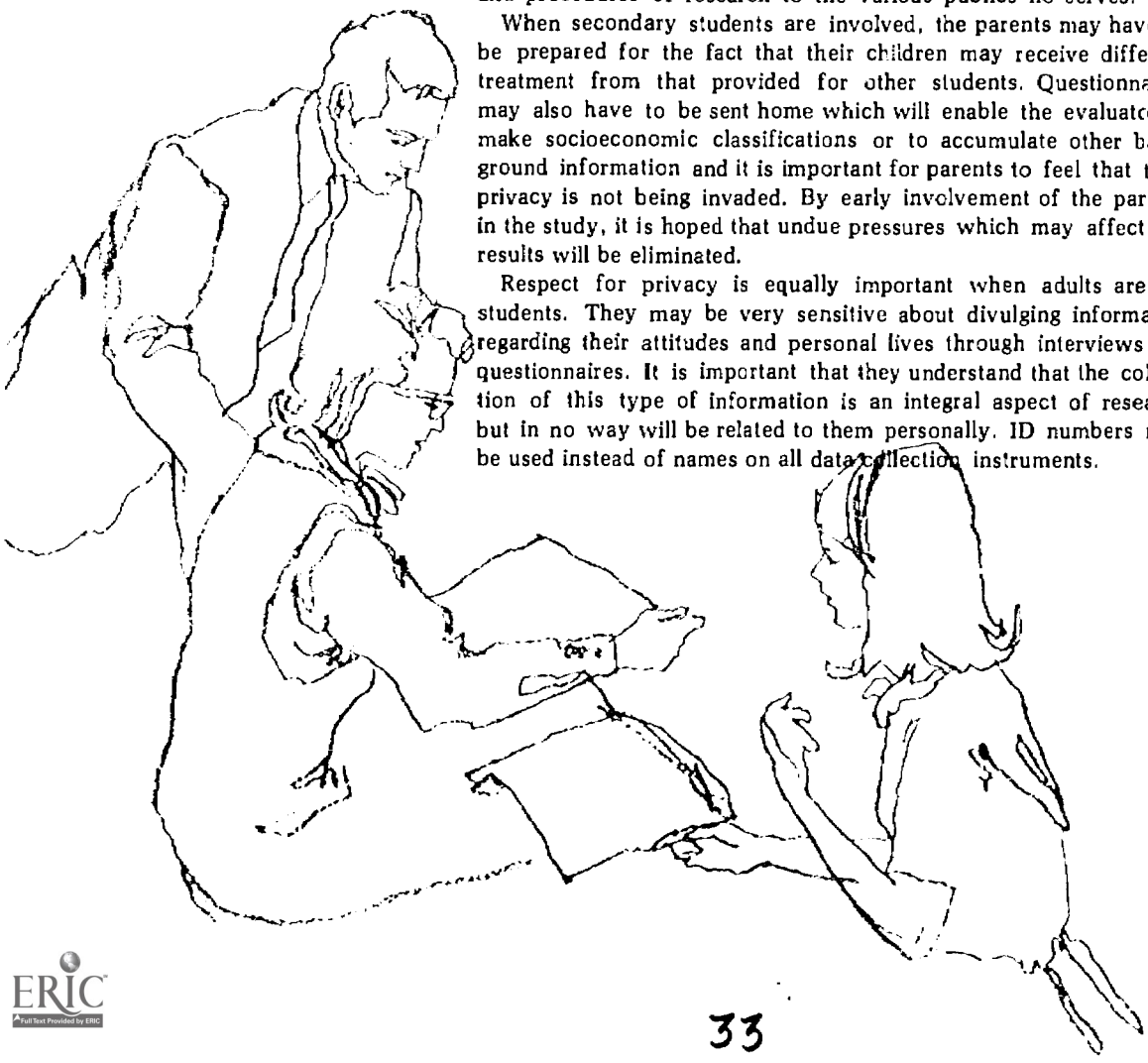
ADMINISTER THE STUDY

Those trying to institute change may meet with some public resistance to their efforts. As many members of the community as is possible should be involved in the evaluation program, such as parents when secondary students are to be participants, interested lay individuals or groups, and professional personnel of the schools. Also administrative officials, politicians, community leaders, and citizens within a community should be informed of the purposes of evaluation. Often the costs involved in research seem unreasonably high to the layman who does not understand what research entails. Here the evaluator may use community group gatherings, the mass media, and opinion leaders to aid in communicating the purposes and procedures of research to the various publics he serves.

When secondary students are involved, the parents may have to be prepared for the fact that their children may receive different treatment from that provided for other students. Questionnaires may also have to be sent home which will enable the evaluator to make socioeconomic classifications or to accumulate other background information and it is important for parents to feel that their privacy is not being invaded. By early involvement of the parents in the study, it is hoped that undue pressures which may affect the results will be eliminated.

Respect for privacy is equally important when adults are the students. They may be very sensitive about divulging information regarding their attitudes and personal lives through interviews and questionnaires. It is important that they understand that the collection of this type of information is an integral aspect of research but in no way will be related to them personally. ID numbers may be used instead of names on all data collection instruments.



A principal should be made aware of the evaluation design so he can offer comments and suggest alternatives before the procedure is actually begun. If he knows what will be expected of him and of his staff, he may be inclined to assume certain responsibilities or make administrative arrangements to facilitate the evaluation efforts. He may permit an unusual scheduling procedure such as double periods or provide particular facilities such as a learning laboratory.

Many teachers are concerned that their students do well compared with others, that their students are at least average, and that people think well of them. It rests with the researcher to acquaint those involved with the purpose of the project which is to evaluate a program, not an individual, a teacher or a school system. Teachers must be made to feel that they are in a cooperative venture and that research is not being forced upon them. Educational innovation may be threatening to teachers, and the possibility of evaluation along with innovation may cause some of them to adopt a negative attitude toward both the curriculum and the evaluation procedures themselves. The teachers who will be working with the Learning 100 materials should be oriented so that they conceive of their role as that of consultants. They must be made aware of the fact that they are not being singled out for evaluation but are assisting in a total evaluation of the instructional program. Control teachers must also be included in training and planning sessions and made aware of the importance of their role in the research.

In addition to the problems of communicating the purpose, value, and results of research to the persons concerned, the evaluator may also have problems in administering his design.

To avoid possible contamination of data, the investigator should try to be aware of:

1. Outside influences that might be responsible for contaminating the measures of gain or loss
2. Inaccuracies in collecting, recording, analyzing or reporting data
3. Standardized tests not administered exactly as directed or administered at inappropriate times
4. Introduction by the teacher of supplementary materials not provided for in the study
5. The teacher who is not sufficiently familiar with the instructional program and who uses instruments and materials in a manner other than that recommended by the producer

An important factor to keep in mind when carrying out the research is to attempt to control the teacher variable. Unless one is trying to evaluate the influence of the teacher, one must attempt to keep the teacher variable as constant as possible, that is, try to

assign teachers who have similar backgrounds and training to the classes involved in the research. Within many adult basic education classes there is great diversity in their training and backgrounds. Some have had little or no training in reading instruction. Others have had little experience with the disadvantaged, particularly with disadvantaged adults. Some are certified teachers. Others have gained all their training or experience in the classroom as paraprofessionals. One should also gather as much of this background material as possible so that it can be considered in light of the results of the study. Also, the amount and type of teacher training in use of innovations such as L-100 programs should be reported.

A twofold problem exists in recognizing and anticipating problems which may occur with materials. First, there is the problem of having the necessary instructional materials which are being used in the study. The evaluator should ensure that enough of the appropriate materials have been obtained to provide for students who may enter the classes at various times during the term. Often, because of budgetary problems, there is a tendency to share instruments and equipment in such a way that prohibits the instruments or materials from being available as required in the program. Beyond this, conserving materials by not using workbooks consumably, often decreases the effectiveness of many of the lessons and increases the difficulty of completing these lessons.

In addition, the use of instruments may be a departure for many teachers. In the orientations, enough time should be provided for the teacher to become fully comfortable with the operation and maintenance of the instruments.

The second part of the problem has to do with the evaluation materials. These include tests, questionnaire forms, interview schedules, and other such items. They should be ordered or prepared well enough in advance so that they are available to the researcher at the time specified. Many research projects have been delayed merely because the tests did not get to the classroom in time.

The problem of mobility of students is one to be considered. If the school conducting the research is in an area where transfers are high, provisions should be made to select a large enough sample to compensate for this loss.

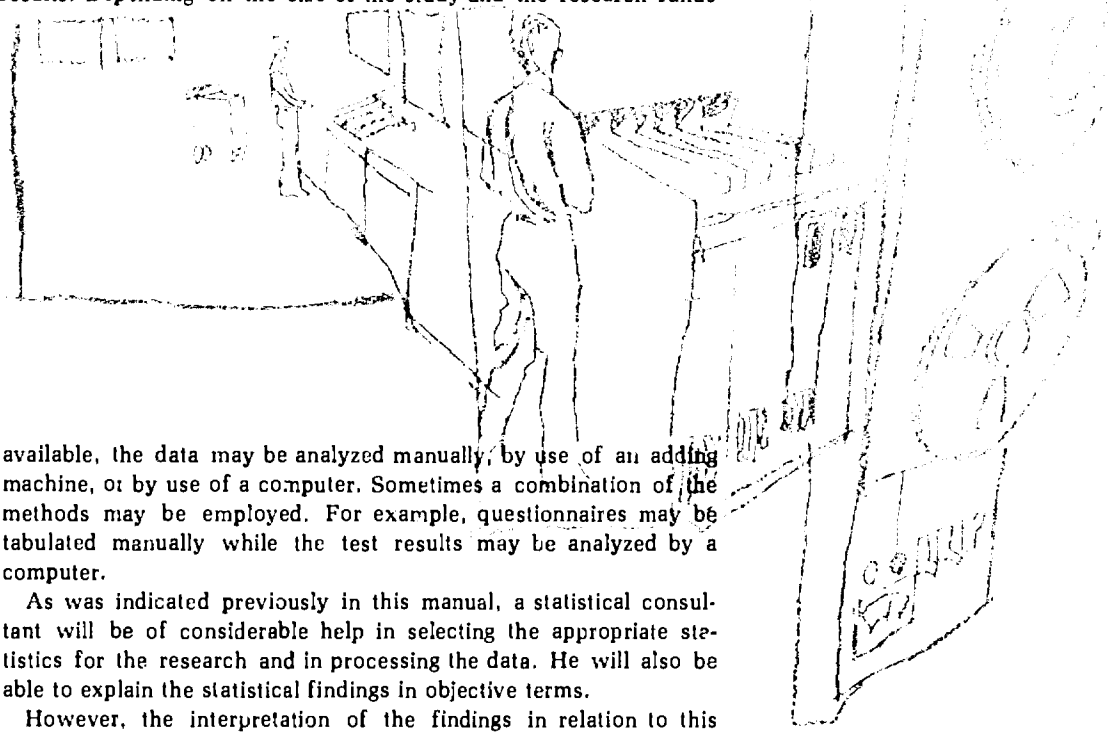
Another threat to the validity of the study is the "Hawthorne Effect," a special motivation effect that can change the behavior of the experimental teachers and pupils. Attempts should be made to compensate for the special treatment this group is receiving. Possibly a placebo situation can be set up in which the control group is made to feel as important as the experimental group by offering some additional materials that have not previously been used in their classroom. If the study is a comparison of the effectiveness of a traditional or existing program with that of L-100,

care must be taken to ensure that this placebo treatment is essentially an extension or an integral part of the existing program rather than a special treatment itself. Another possibility is the designation of two control groups, one using a conventional program, the other an alternate innovation.

An investigator's sensitivity to what might happen places him in a better position to meet the various contingencies and sharpens his awareness of what is occuring during the transactions.

ANALYZE DATA AND INTERPRET RESULTS

After the data from the study have been collected and prepared for analysis, the evaluator must analyze the data and interpret the results. Depending on the size of the study and the research funds



available, the data may be analyzed manually, by use of an adding machine, or by use of a computer. Sometimes a combination of the methods may be employed. For example, questionnaires may be tabulated manually while the test results may be analyzed by a computer.

As was indicated previously in this manual, a statistical consultant will be of considerable help in selecting the appropriate statistics for the research and in processing the data. He will also be able to explain the statistical findings in objective terms.

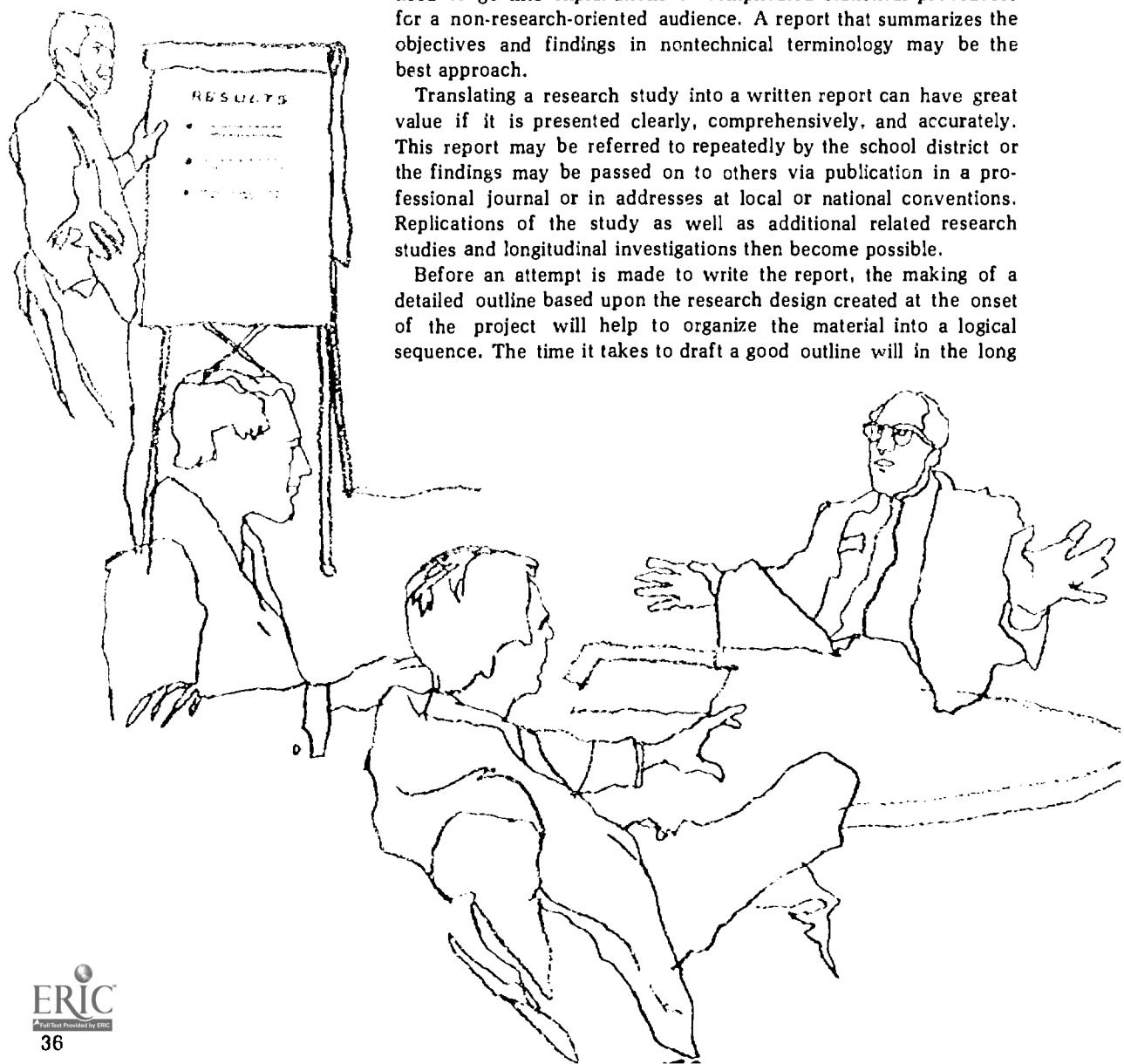
However, the interpretation of the findings in relation to this instructional situation must always be made by the educator. He may find one group made statistically significant gains over another group on the achievement test, but the group that did less well on the achievement test significantly increased their listening skills. Therefore, the educator would need to determine what was responsible for this discrepancy in relation to the entire study. He would then report the findings and his interpretation of the findings based on the data received from the study.

REPORT THE RESULTS

The final research procedure is to describe the study, either formally in a written account or informally, perhaps before community or parent groups, other teachers, or the Board of Education. The simplicity or degree of sophistication of the written report will depend upon the audience for whom it is intended. There is no need to go into explanations of complicated statistical procedures for a non-research-oriented audience. A report that summarizes the objectives and findings in nontechnical terminology may be the best approach.

Translating a research study into a written report can have great value if it is presented clearly, comprehensively, and accurately. This report may be referred to repeatedly by the school district or the findings may be passed on to others via publication in a professional journal or in addresses at local or national conventions. Replications of the study as well as additional related research studies and longitudinal investigations then become possible.

Before an attempt is made to write the report, the making of a detailed outline based upon the research design created at the onset of the project will help to organize the material into a logical sequence. The time it takes to draft a good outline will in the long



run prove an economy. In spite of their differences, research studies are similar enough to suggest a typical organization such as the following:

I. Presentation of the Problem With Which the Study Deals
   A. Summary of local issues
   B. Statement of solution being sought
II. Background for Study
   A. Related literature
   B. Prior studies
III. Procedures Employed
   A. Description of population and samples used
   B. Objectives or hypotheses being tested
   C. Instrumentation and data collection methods
   D. Summary tables
   E. Methods of analyzing data
      1. Statistical tests
      2. Levels of decision
IV. Results
   A. Presentation of findings
   B. Analyses of findings
V. Discussions
   A. Reference to objectives or hypotheses being tested
   B. Implications and recommendations for additional studies
VI. References
   A. Bibliography
   B. Appendix, if desired

The first section dealing with the presentation of the problem might include background information explaining the importance of the particular study including a summary of local issues, a statement of the purpose of the study and its significance, hypotheses and limitations of the study, underlying assumptions, and definitions of important terms.

The section dealing with related literature indicates the pertinent knowledge gained through a review of the literature on the problem and summarizes other research studies relevant to the present investigation.

Next, there is usually an account of the procedures employed, describing how the design has been carried out. Here, information is presented regarding the location of the study; the size and selection of the sample; the incomes, occupations, and educational levels of students (ABE) or the families of the students included in the sample; the experience and educational background of the teachers involved; and experimental and control techniques. The instruments selected and the reasons for their selection, methods of data collection, and time schedules should be described. A clear,

understandable statement of the methods of analyzing the data, including statistical tests used and levels of significance decided upon, is needed.

The section dealing with results and conclusions of the study is a crucial one. The value of the research lies in the consistency of the conclusions drawn from the results obtained. One approach that may prevent inconsistency is to organize the chapter by restating each hypothesis tested, to give the related data in tables and text, and then to formulate a conclusion. If this format proves too repetitive, results for several hypotheses might be summarized in a single table permitting meaningful comparisons among related data. Generous use of tables enables the reader to study and compare numerical data efficiently.

The section on results and conclusions is also an appropriate place in the written report to present a summary of the research performed. A short review at this point refreshes the reader's memory without requiring that a profusion of details be read. A brief statement of the problem area, the specific purpose of the investigation, testable hypotheses, the methods and procedures used, the procedures for obtaining data, and some of the more important results will aid the reader to refocus on various aspects of the total research problem.

The section discussing the implications of the study should also refer back to the broad objectives being tested and outline the findings in relation to the problem being investigated. In addition, the relationship of results of past research and the present findings might be discussed. Ideas on extended meanings of the findings for additional studies may be stated here. Negative, nonsignificant, or unexpected findings should be included. An identification of the problems not solved by the present research might suggest recommendations for future research. Possibly there are faults in the study which a critical analysis of the design will bring to light.

IMPLEMENT FINDINGS IN THE CURRICULUM

After an educator has completed the evaluation of a particular instructional system within his educational setting, he then examines the findings in order to make decisions regarding curricular change. Perhaps the most central, but often the least used function of evaluation is to validate the hypotheses upon which the curriculum is based. When establishing an evaluation procedure such as that described in this manual, it is first necessary to review instructional objectives and to examine them in relation to the objectives of the particular innovation that is to be used. As a result of the study, an educator may determine that his instructional objectives need to be revised, or he may find that the innovative program

can justifiably replace the existing program or that adaptations of the innovative program will be necessary to produce optimum results in his particular situation. The forward-looking educator, however, keeps in mind that all curriculum plans and approaches to instruction are only hypotheses which need to be tested. This is true of established curriculum practices as well as innovations.

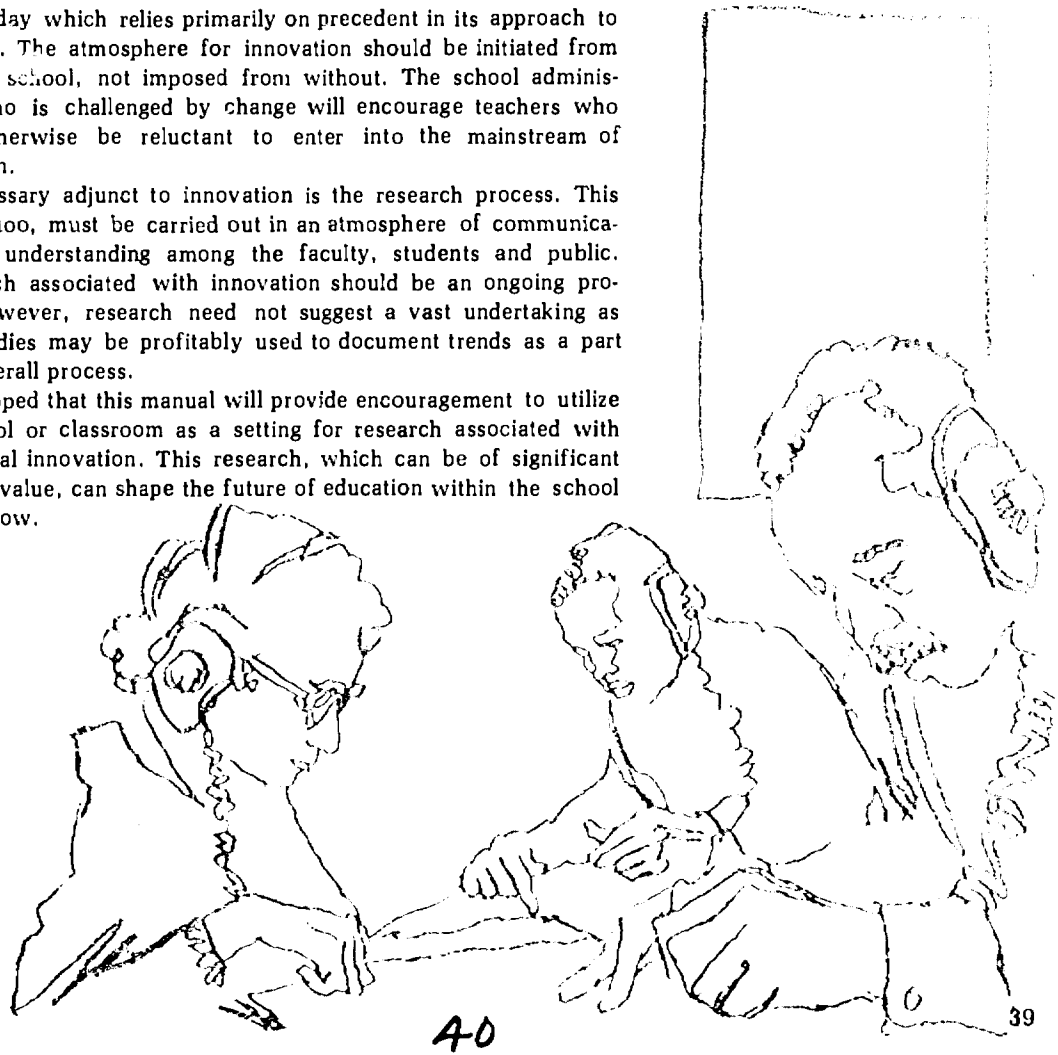
Another important function of the evaluation of instructional programs is to provide information on student achievement. The very continuity of curriculum and learning depends on such information. Many problems of articulation between the various levels of schooling exist because of insufficient knowledge about what precisely the students have mastered on the previous level.

The innovative school is the school of tomorrow — not the school of yesterday which relies primarily on precedent in its approach to education. The atmosphere for innovation should be initiated from within a school, not imposed from without. The school administrator who is challenged by change will encourage teachers who might otherwise be reluctant to enter into the mainstream of innovation.

A necessary adjunct to innovation is the research process. This process, too, must be carried out in an atmosphere of communication and understanding among the faculty, students and public.

Research associated with innovation should be an ongoing process. However, research need not suggest a vast undertaking as small studies may be profitably used to document trends as a part of the overall process.

It is hoped that this manual will provide encouragement to utilize the school or classroom as a setting for research associated with educational innovation. This research, which can be of significant practical value, can shape the future of education within the school of tomorrow.



APPENDIX A
OVERARCHING AND SUBSYSTEM OBJECTIVES OF LEARNING 100

OVERARCHINC OBJECTIVES

- To develop perceptual accuracy and visual efficiency
- To enrich experiential background
- To develop an extensive vocabulary
- To develop word attack skills
- To develop and increase ability to direct and sustain attention
- To develop fundamentals of reading and listening comprehension
- To develop interpretative reading and listening skills
- To develop critical reading and listening skills
- To develop analytical reading and listening skills
- To develop the ability to locate and use reference sources
- To develop efficient study skills and learning approaches
- To encourage individuals to progress at their own rate and to interact directly with the materials in an independent manner
- To provide a continuous and effective program of student evaluation and reinforcement
- To provide the instructor with an instructional system that will interest and motivate undereducated adults, out-of-school youths, and potential dropouts to develop basic communication skills

SUBSYSTEM OBJECTIVES

LEVELS RA-CA

Perceptual Accuracy and Visual Efficiency

- To develop ability to recognize rapidly, retain accurately and in a left-to-right direction symbols, numerals, and letters presented by the Tach-X
- To develop a sense of spatial relationships as it relates to reading and writing; accurate visual discrimination as it relates to the identification and recognition of numerals and letters; and facility in writing numerals and letters by use of a workbook
- To develop ocular facility and strengthen habits of good directional attack, as they relate to silent reading, by scanning elements projected in a left-to-right manner on the Controlled Reader at rates that approximate fluent silent reading

Building Experiences

- To prepare the students for subsequent instruction by voluntary discussion and student response to questions through instructor-mediated activities
- To encourage ease of student interaction and improve oral language facility by the relating of experiences through instructor-mediated activities
- To encourage development of social living skills

Skill Building

Word Introduction

- To build a vocabulary using an Aud-X presentation
- To develop independence in word attack skills within the context of a word study lesson using an Aud-X presentation
- To reinforce a recognition vocabulary within the context of an Aud-X presentation involving independent activity
- To develop a variety of comprehension skills through listening experiences provided by the Aud-X

Word Recognition Training

- To develop sight recognition of all words introduced by the Aud-X by reducing the recognition time through the use of the Tach-X
- To develop ability to use context clues as an aid to word recognition through use of workbook activities
- To introduce elementary principles of language usage that concentrate on word changing principles through instructor-mediated activities
- To further reduce recognition time of sight words and increase the rapidity with which an individual associates words by presentation of a running context on the Controlled Reader
- To extend comprehension skills by student response to questions relating to a running context presented on the Controlled Reader

Reading Fluency Development

- To reinforce and integrate all the visual, functional, perceptual and associative skills acquired in the preceding skill-building activities by Controlled Reader-mediated silent reading exercises
- To further develop comprehension skills through independent Controlled Reading workbook activities

Application and Enrichment

- To further develop sight recognition of vocabulary by means of the Flash-X
- To reinforce the perceptual and associative skills acquired in the preceding skill-building activities by means of student and instructor-mediated workbook exercises
- To develop and reinforce skills of comprehension, interpretation, and evaluation by means of workbook and instructor-mediated activities

LEVELS DA-FA

Perceptual Accuracy and Visual Efficiency

- To develop ability to recognize rapidly, retain accurately and in a left-to-right direction symbols, numerals, and letters presented by the Tach-X (as needed)
- To develop ocular facility and strengthen habits of good directional attack, as they relate to silent reading, by scanning elements projected in a left-to-right manner on the Controlled Reader at rates that approximate fluent silent reading (as needed)

Building Experiences

- To prepare the students for subsequent instruction by voluntary discussion and student response to questions through instructor-mediated activities
- To encourage ease of student interaction and improve oral language facility by the relating of experiences through instructor-mediated activities
- To encourage development of social living skills

Skill Building

Listening and Study Skill Development

- To develop listening comprehension skills (Level DA), listening comprehension and reading skills (Level EA), and listening comprehension and writing skills (Level FA), through the use of recordings or tapes and independent workbook activities
- To develop reading skills of interpretation, organization, evaluation, and reference by student-mediated manipulation of study skills materials

Word Recognition and Spelling

- To develop ability to use context clues as an aid to word recognition by use of workbook activities
- To develop sight recognition of words introduced by reducing the recognition time through use of the Tach-X or the Flash-X
- To develop spelling skills through use of the Tach-X and a workbook and instructor-mediated activities
- To develop skills in dictionary usage through workbook activities

Reading Fluency Development

- To reinforce and integrate all the visual, functional, perceptual and associative skills acquired in the preceding skill-building activities by Controlled Reader-mediated silent reading exercises
- To further develop comprehension skills through independent Controlled Reading workbook activities
- To reinforce the perceptual and associative skills acquired in the preceding skill-building activities by means of student and instructor-mediated workbook exercises
- To develop and reinforce skills of comprehension, interpretation, and evaluation by means of workbook and instructor-mediated activities
- To further develop and reinforce word attack skills by means of the Aud-X and independent workbook activities
- To reinforce ability to utilize comprehension skills by means of the Controlled Reader and independent workbook activities

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APPENDIX B
TAXONOMY*

OBJECTIVES	EXPERT OPINION			INTERPRETATIVE & ANALYTIC STUDIES		
	(1)	(2)	(3)	(4)	(5)	(6)
Educator would choose L-100 objectives he wants to evaluate and select an appropriate instrument from the taxonomy.	**Consulting: Telephone Letter In Person**	**Preparation of Position Papers**	**Meetings**	**Tertiary Sources**	**Secondary Sources**	**Primary Sources**
	Locate people doing similar or related research and inquire as to their methods and results. This may help eliminate invalid methods in advance.			Read professional journals and send for reports and papers prepared by individuals engaged in similar research. Determine if your hypothesis or statement of what you hope to find is valid – if it is based on legitimate premises.		

BEHAVIOR OBSERVATION			
(13)	(14)	(15)	(16)
Subjective, Global Observers	**Controlled Observation (Judges)**	**Frequency Counting (Coding)**	**Personality**
Various individuals observe if students demonstrate appropriate behavior and demonstrate that learning has taken place.	A more rigorous method whereby observation techniques are standardized so those by different observers are comparable.	A count of the number of students or items that demonstrate various behaviors.	Major problem of this measur is validity. Items do not always measur what we think they measure.

*Taxonomy developed by The Institute for Educational Development, New York, N.Y., John Kennedy, Vice President

	SURVEYS				
(7) **Computer Simulation**	(8) **Public Opinion Polling**	(9) **Questionnaires**	(10) **Interviews**	(11) **Unobtrusive Measures**	(12) **Nonstandardized Tests**
Establish a mathematical model of a process. Use computer to test the model.	Opinions of those directly or indirectly involved.	A self-administered instrument that has questions or items, either closed, fixed alternative, or unstructured.	Directly question person to obtain answers pertinent to the purposes of the research problem. Interview can be structured or unstructured, standardized or nonstandardized.	Information gained indirectly. Person involved not aware of measure being used to gain information.	This includes teacher-made tests designed to determine if the students can demonstrate that they can apply their learning. Results of the test may be used when comparing a control group and experimental group.

	STANDARDIZED TESTS				LABORATORY MEASUREMENT	
(17) **Attitudes and Values**	(18) **Intelligence**	(19) **Achievement**	(20) **Skills**	(21) **Physical Health Related**	(22) **Environment Simulation**	(23) **Independent-Dependent Variables Control Group**
Measurement of how one thinks, feels, perceives, or behaves to an outside stimulus.	Omnibus measures (includes verbal, numerical, spatial items in one instrument that correlates highly with school achievement).	Measures present proficiency, mastery, and understanding of general and specific areas of knowledge.	For measuring limited areas of achievement of proficiency.	Indicate disabilities as they affect learning and scores on tests.	Selected group of subjects are randomly assigned to various groups, and the experimental group is exposed to learning situation; but variables due to environmental differences are reproduced and observed – not omitted.	The most rigorous technique whereby all variables are matched or controlled so all differences can be attributed to the treatment – not individual differences.

APPENDIX C
OUTLINE OF STATISTICAL TESTS

Experimental design and statistics can be the life work of a specialist but it can also be a useful tool for the teacher, the administrator, and the members of the school board. It can answer questions with a predetermined degree of precision that we would otherwise have to answer with subjective judgments or opinions such as, "I feel this curriculum will be good for the kids," or, "I hope this curriculum will be good for the kids."

There are complex formulas and computers, and talk of split-plot and Latin Square designs, but there are also basic designs that are appropriate and useful and for which the logical rationale should be clear to a reader regardless of his degree of statistical sophistication.

A few such experimental designs will be introduced in this section which have been selected because they can be used in most school-oriented research. The assumptions and the formulas will be left in the adequate hands of the textbook authors who have been cited in the bibliography. The concern here is only of statistics as a tool for decision making and improvement of the individual learning situation and environment.

The t-test

In many experimental situations one measurement and only two groups, the experimental and the control group, are required. A classroom might be used as a population and students would be randomly assigned to one group or the other, or a school system might constitute the population and classroom units would be assigned to treatment groups. This design would be useful for testing the relative effectiveness of a traditional and an experimental curricula. For example, when only two groups are involved, a statistical test, the t-test, is appropriate. The t-test value reflects the degree of difference between two means and the value obtained from computation of the t-test formula can be checked against prepared and readily available tables to judge whether or not the computed value from the data is significantly large enough to be considered statistically different from chance. A brief look at the computational formula for the t-test and a little simple arithmetic will show that three factors affect the size of the computed value.

1. The magnitude of the differences between *means* of the two groups should be large, the larger the difference the better the chance for significance.
2. The amount of *variance*, differences within each group, is also vital. If the groups have large variability a great deal of overlap is present, but if the variance of the groups is relatively small, far less difference between means is required to give significant results.
3. Finally, the *size of the sample* (the total number of individuals or classroom units) is important. As the sample size increases, the value that you computed from the t-test formula increases and the experiment is more apt to yield significant results.

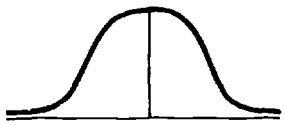
In summary, the t-test is an extremely useful and fairly simple way to test the significance of mean difference between two instructional approaches.

Analysis of Variance

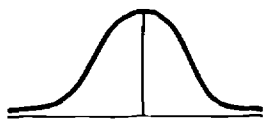
If three or more groups are involved in an experiment, the t-test is no longer an

appropriate test but an extention of the t-test, the F-ratio can be used. The F-ratio is the arithmetic end result of a statistical test called Analysis of Variance. When testing the degree of difference between means for three or more groups the variance within the individual groups is used. It seems circular and most confusing but a simple diagram suggested by Popham (1967) makes the whole process seem quite logical.

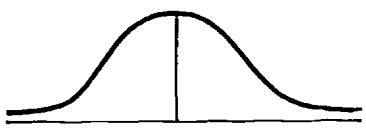
Assume a classroom teacher or an administrator wished to test a traditional program against two different experimental programs. In other words, he has a control group and two experimental groups. After he administers the posttest to the three groups he can graph his results horizontally, using the same scale for all groups and the total sample. Figure 1 shows this graphic representation.



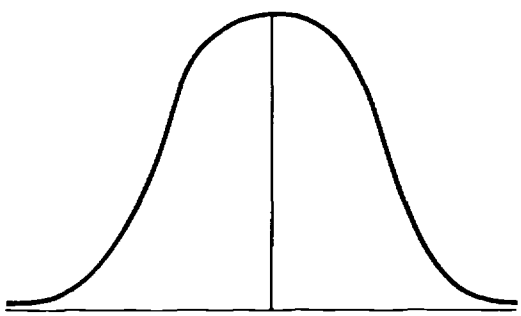
Mean $\overline{X}$=103
Control Group (C)



Mean $\overline{X}$=104
Experimental Group I (E_1)
(Treatment I)



Mean $\overline{X}$=101
Experimental Group II (E_2)
(Treatment II)



Composite Mean $\overline{X}$=102.67
$C + E_1 + E_2$=Composite graph

FIGURE 1

The so-called null hypothesis, the statement that no difference exists following administration of the treatments, is certainly true in this case. It is easy to see that when the results for all the subjects are graphed together as in the bottom graph in Figure 1, the variances or spread of scores is little different from the variance within the individual groups.

Now assume that the teacher or administrator wishes to test two other experimental programs. Following administration of the experimental treatments he again graphs the results of the posttests. Figure 2 shows these results graphically.

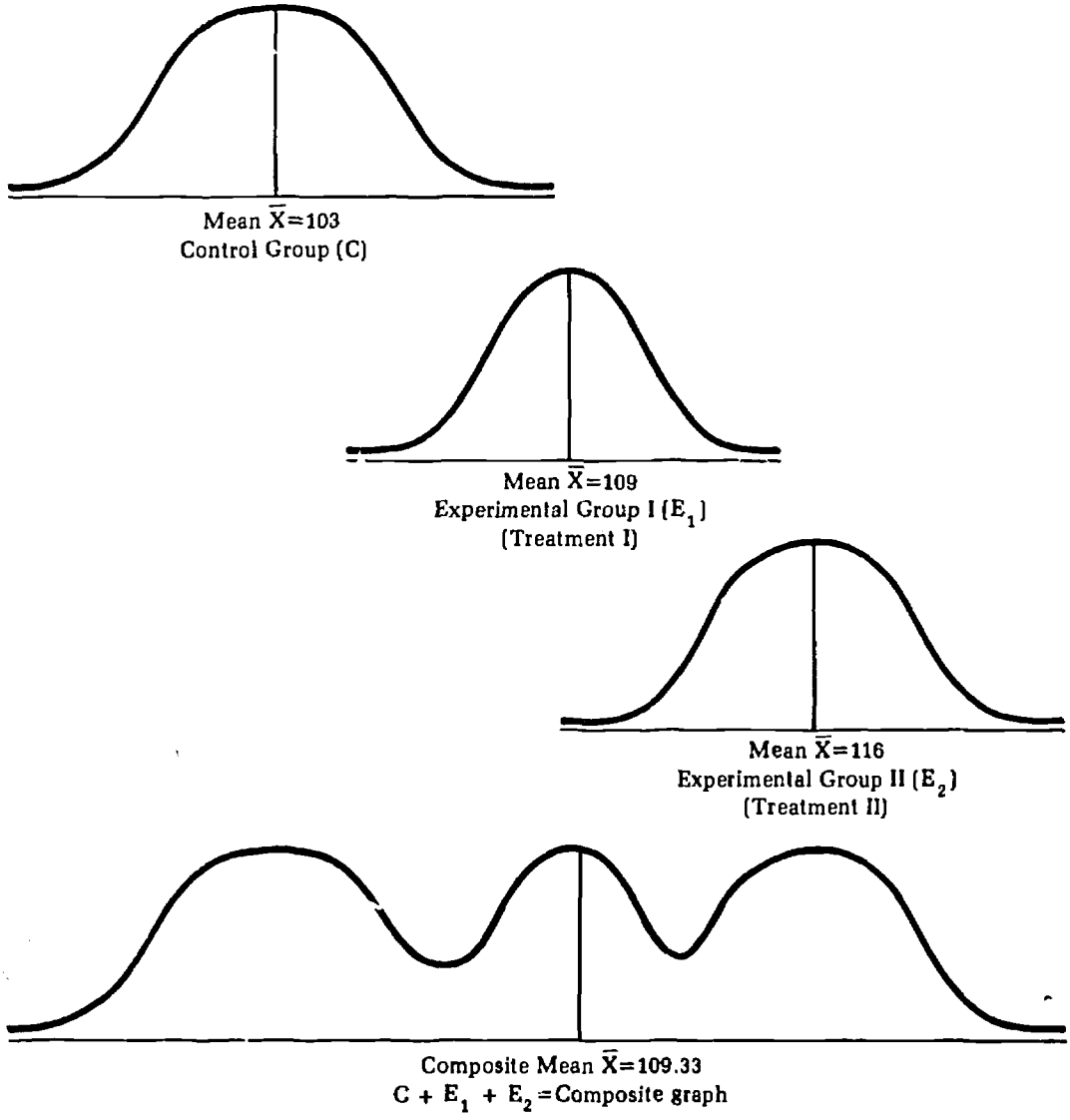


FIGURE 2

In this case, the null hypothesis cannot be considered to be true. It is obvious that when the three groups are graphed together as in the bottom graph in Figure 2, the variance or spread of scores is far greater than the variance of any single group.

It is possible to test to see if any two of these groups, for example Treatment I and Treatment II, are significantly different from each other. This is done by multiple-comparison tests, and is well defined by Winer (1962). It is best to procure the assistance of a research design consultant in interpreting the results of a multiple-comparison test. This technique could be very useful to an administrator faced with the decision of which new materials should be purchased. If Treatment I is not significantly different from Treatment II and yet Treatment II is only sixty per cent as costly as Treatment I, the school board would be much happier to purchase Treatment II for the district.

In summary, the Analysis of Variance and the resulting F-ratio is a design which can be used to advantage when three or more groups are involved in the experiment. It is really an extension of the t-test and, therefore, the factor of size of differences between means, size of variance within the groups, and sample size have much the same effect.

Analysis of Covariance

A favorite word of statisticians is power. They talk of powerful tests and how to achieve power. It means, quite simply, that if one goes to the trouble to run an experiment, as much of the chance bias and experimental contamination as possible must be removed. One way to increase power is to remove by arithmetic procedures as much of the variance as possible that is due to factors other than the treatments administered to the subjects. Remember that a small variance is desirable if we hope to get significant results.

Even if the groups are selected at random, as statisticians demand, it is very difficult to select groups at random that are truly equal on all dimensions such as spatial ability, auditory discrimination, and paragraph meaning. The variance due to these initial and almost inevitable differences can be removed by using a statistical formula that makes the groups statistically equal. The formula is a combination of Analysis of Variance and regression analysis. The formula appears forbidding and the arithmetic does become complex, but a design specialist and a computer can unravel the signs and symbols very quickly.

The Analysis of Covariance technique can be used appropriately and to great advantage with two or more groups when initial and final measurements are available and offers us a powerful statistical tool. It is a bit more complicated arithmetically, but the results may be far more gratifying.

Factorial Design

To this point, only experimental designs that test one dimension have been discussed, for example, testing the relative effectiveness of treatments in order to make a decision about different curricula. Now assume that the curricula with respect to different kinds of students is to be tested. The evaluator might want to know if Treatment I is more effective for high-ability students and Treatment II is more effective for low-ability students. Even though Treatment II costs less money, it might be possible to buy Treatment I for certain areas or types of students if it proves to be particularly effective.

Now a design that is two or more dimensions is needed. To the one dimension treatment discussed before, a second dimension, ability level, is added. The design schemata would then look like this:

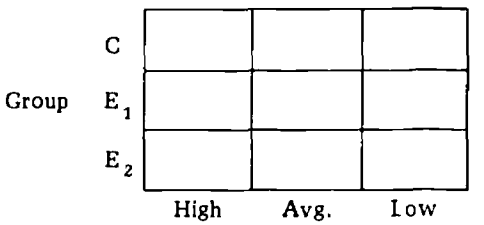


FIGURE 3

Each experimental unit is now placed in the appropriate cell. For example, the scores of a high-ability student who was randomly placed in the control group would be in the upper left cell and the score of an average-ability student randomly placed in Experimental Group 1 would be in the middle cell.

Now, again with some arithmetic, one can test the curriculum as well as gain information to help to make decisions about the programs for different types of students. The statistical concept of interaction rears its complex head at this point and design consultants will be happy to draw graphs and talk of four-factor interactions which have little interpretable meaning for our curricular improvement. Two-factor interactions, however, are not only meaningful but very helpful.

Correlation

Often an evaluator wants to know whether things go together or seem to be at odds with each other. For example, it would be helpful to know whether or not all children who attend school every day consistently get the best grades in the class. If this is true, a correlation coefficient can be computed and a high value expected (less than but very close to $+1.0$). This would indicate that the work done in the classroom by those students with high attendance was very effective. If, however, the computed correlational value was low (very near zero and either positive or negative) one would be led to believe that school attendance had relatively little effect on grades or achievement in school. Now assume that the computed correlation coefficient is high but negative (greater than but very close to -1.0). This would mean that the children who attend school regularly are actually being hurt by the experience and students with poor attendance are becoming better achievers.

The correlation technique is simple, though tedious to use, and requires only measurement of the two factors of interest. After the correlation is computed, a test is available in textbooks that can be used (or one can refer to a table in many statistical books) to determine whether the correlation is really significant or simply due to chance. Smaller values of the correlation coefficient are significant if the sample size is large enough since a large sample will provide a more representative index of the relationships under consideration.

A very useful tool, the correlation coefficient can provide information relationships such as age and vocabulary, parents' occupational level and achievement scores, and attendance and curriculum program effectiveness.

Use the correlation coefficient generously. It can provide a great deal of meaningful information to the teacher and evaluator.

APPENDIX D
SAMPLE QUESTIONNAIRES

LEARNING 100 END OF YEAR REPORT

Teacher _____ Date _____

Location _____ Installation Number _____

_____

List alphabetically the names of the students in your class, last name first.
Indicate for each student:

1. The last cycle and level completed.
2. Exposure speed at Tach-X for Tach-X Word Recognition exercises for the last cycle and level completed. (Indicate exposure speed as A, B, C, D, E, or F.)
3. Projection rate for Controlled Reader Story for the last cycle completed. (Indicate rate as 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, or 130.)
4. Projection rate for Processing Training for the last cycle and level completed. (Indicate rate as 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, or 130.)

Student's Name	(1) Last Cycle and Level Completed	(2) Tach-X Dial Setting	(3) Controlled Reader Dial Setting	(4) Processing* Training Dial Setting

cate P for Processing Motor, R for Regular Motor

Check one appropriate statement in each of the following groups.

Students' interest level in the use of the instruments:

_____ Remained high during the school year
_____ Started high and diminished as time progressed
_____ Started low and increased as time progressed
_____ Remained low during the school year

Teacher reaction to the program:

_____ I am comfortable with the program and enjoy using it
_____ I am comfortable with the program but do not enjoy using it
_____ I feel overwhelmed by the program and do not enjoy using it
_____ I feel overwhelmed by the program but still enjoy using it

Teacher evaluation of the program:

_____ The program is superior to others I have taught
_____ The program is comparable to others I have taught
_____ The program is inferior to others I have taught
_____ This is my first teaching experience

Check as many statements as apply:

_____ Too much time is involved in planning for each day
_____ One teacher can easily handle the program
_____ I would like to use this program again next year
_____ Substitute teachers can manage the program if the teacher is absent

Have you had any assistant working with you in the L-100 program this year?

Yes _____ No _____

If yes, indicate below the type of assistant you have had.

	How Many?	How Frequently?
Teacher's Aide	_____	_____
Student Teacher	_____	_____
Certified Teacher	_____	_____
Reading Specialist	_____	_____

List number of students in each reading group (Aud-X or Controlled Reader) in your classroom:

Group 1 _____ Group 2 _____ Group 3 _____ Group 4 _____ Group 5 _____

When scheduling problems arise and you must deal with the pressures of too little time to complete all the suggested L-100 activities in the time available, which of the L-100 activities listed do you eliminate occasionally?

Please check as many as necessary.

_____ 1. Building of experiences for Aud-X stories

_____ 2. Planning of class and personal agenda for the day

_____ 3. Tach-X ABC Accuracy Training

_____ 4. Controlled Reader Motility Training

_____ 5. Aud-X Story and Word Study (Levels RA-CA)

_____ 6. Aud-X Listen, Listen and Read, Listen and Write (Levels DA-FA)

_____ 7. Tach-X Word Recognition Training

_____ 8. Controlled Reader Processing Training

_____ 9. Controlled Reader Fluency Training (stories)

_____ 10. Check gains in reading rate and comprehension with Reading Efficiency Checks

_____ 11. Planning reading activities

_____ 12. Conducting teacher-pupil conferences

_____ 13. Using Study Skills Library

_____ 14. Using Flash-X to practice words

_____ 15. Reviewing Aud-X, Tach-X or Controlled Reading lessons according to specific needs

_____ 16. Practice handwriting

_____ 17. Independent reading or directed reading in GO

_____ 18. Sharing of library books

_____ 19. Reading favorite stories, or poems orally

_____ 20. Dictating or reading into tape recorder and listening to recording

_____ 21. Class or group discussions of topics of interest

_____ 22. Practical and creative writing

_____ 23. Review word attack skills in Aud-X Word Attack Review Study Guide

_____ 24. Directed reading with Comprehension Power filmstrips

Approximately how much time each day is devoted to:

Perceptual Accuracy and Visual Efficiency Training	_____ minutes
Building Experiences	_____ minutes
Skill Building	_____ minutes
Application and Enrichment	_____ minutes
Total time devoted	_____ minutes

Place a check in the column that best describes your opinion of the instructional effectiveness of each of the L-100 materials listed below:

	Outstanding	Good	Average	Fair	Poor
Instructor's Manual					
Cycle Lesson Plans					
Tach-X Accuracy Filmstrips					
Eye-Hand Coordination Workbook					
Controlled Reading Accelerated Discrimination Filmstrips					
Motility Training Filmstrips					
Aud-X Word Introduction Filmstrips					
Aud-X Study Guides					
Tach-X Filmstrips					
Tach-X Word Recognition Books					
Controlled Reading Study Guides					
Controlled Reader Filmstrips					
GO Books					
Processing Filmstrips					
Study Skills Library					
Reading Efficiency Checks					
Aud-X Word Attack Review Book					
Comprehension Power Filmstrips					
Listen Lesson Book					
Listen and Read Lesson Book					
Listen and Write Lesson Book					
Flash-X Word Discs					

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CONTROL CLASS QUESTIONNAIRE
END OF YEAR REPORT

Teacher _____ Date _____

Location _____ Installation Number _____

_____

1. What instructional program are you using with your class?

_____

2. List supplementary reading or skill materials used in your classroom in addition to the basic instructional program.

_____

_____

_____

_____

_____

3. Approximately how much time each day is devoted to:

Skill Building _____

Application and Enrichment _____

Additional Activities _____

4. Have you had any assistant working with you this year? Yes _____ No _____

If yes, indicate below the type of assistant you had.

	How Many?	How Frequently?
Teacher's Aide	_____	_____
Student Teacher	_____	_____
Certified Teacher	_____	_____
Reading Specialist	_____	_____

5. List the number of students in each reading group in your classroom.

Group 1 _____ Group 2 _____ Group 3 _____ Group 4 _____ Group 5 _____

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GLOSSARY OF RESEARCH AND EVALUATION TERMS USED IN THIS MANUAL

Autoinstructional Devices — Systems and instruments for individual instruction, including individual reading devices, individual viewing and listening equipment, language laboratories, and programmed printed materials

Control Group — In an experiment, the group or groups that are not subjected to the experimental factor, and with which the experimental group is compared

Data — Factual material used as a basis especially for discussion or decision

Data Analysis — The interpretation of numbers, facts, or other quantities used to draw conclusions or to make statistical inferences

Evaluation — The process of judging the value of something by careful appraisal, informally by casual observation and subjective judgments, or formally by controlled comparisons

Experiment — A tentative procedure or policy accompanied by control of conditions and/or controlled variation of conditions together with observation of results to test or establish a hypothesis

Experimental Group — In an experiment, the group that is subjected to the factor being tested in a study of its affect on the group

Hypothesis — A conjectural statement of the relation between two or more variables

Instrument: Instructional — An electrical or mechanical device used to implement an educational program

Instrument: Testing — A measuring device for determining the present value of a quantity under observation

Interval Scale — A form of measurement where items are selected so that the scale intervals between the items are equal; having all the characteristics and relationships of the ordinal scale, except that the distances between any two numbers on the scale are of known and equal size; the ratio of any two intervals is independent of both the zero point and the unit used. (In other words, the zero point and the unit of measurement used on the scale are arbitrary. Thus, an IQ of 120 does not indicate twice as much intelligence as an IQ of 60 since there is no such quantity as zero IQ)

Mean — The sum of a set of scores divided by the number of scores; commonly called the average.

Measurement — The practice of testing, scaling, and appraising aspects of the educational process and of the individuals undergoing the educational process

Multimedia Approach — Instruction that utilizes a variety of media: filmstrips, records, tape recordings, books, instruments, etc.

Multimodal Approach — Instruction that enables children to capitalize on their preferred learning style: aural-oral, visual-oral, tactile stimulation, etc.

Nominal Scale — A form of measurement which classifies items into two or more categories without any reference to their magnitude (such as identifying "boys" and "girls" as B and G or as 1 and 2) and with no particular order assigned to the categories, although numbers may be assigned to them

Norm — Average or typical performance

Objective — Something toward which effort is directed; an aim or end of action, a goal

Operational Objective — A description of what the learner will be doing, the conditions under which the behavior will occur, and the criterion of acceptable performance

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Ordinal Scale — A form of measurement used when the categories within a scale not only differ but also have a distinct relationship such as a preferred order allowing the researcher to assign values that permit observations to be placed in relative rank order only; no implication as to the distances between positions can be assigned to the ranking; it assigns observations to categories by number and arranges them in some logical order (such as ranking achievement on a particular test instrument from high to low)

Overarching Goals — Long-range general statements which reflect the anticipated outcomes of the program in terms of the author's philosophy rather than in terms of students' demonstrable behavior

Population — A total group of individuals, objects, or items from which samples are taken for statistical measurement

Probability — The likelihood that any one of a total number of events will occur in a situation involving chance

Program — A number of activities properly organized into learning units for the purpose of attaining specified educational objectives

Programmed Instruction — The utilization of programmed materials to achieve educational objectives; synonymous with autoinstruction, automated teaching, etc.

Random Sample — A sample drawn in such a way that every member of the population has an equal chance of being included, thus eliminating bias of selection, it is "representative" of its total population

Ratio Scale — A form of measurement using equal units throughout the range of the scale, an absolute zero point representing complete absence of the property being measured and the ratio of the scale units independent of the unit of measurement. (For example, six pounds are twice three pounds, six feet are twice three feet, and six minutes are twice three minutes.) All quantification and computation which can be performed by the nominal, ordinal, and interval scales may also be accomplished on the ratio scale and also it is possible to divide by the categories or divide by the numbers on the scale itself

Reliability — The degree to which an evaluation instrument measures accurately or consistently whatever it proposes to measure

Research Design — A plan by which research samples may be selected from a population and under which experimental treatments are administered and controlled so that their effect upon the sample may be measured

Sample Population — The individuals selected from a total population, or universe, for the purpose of studying certain characteristics that will reveal truths concerning the population from which they are selected

Search (seeking material) — The operation to determine whether certain information is available, the manner in which it is organized, and where it is located

Skill — An ability that is essential to successful performance

Statistically Significant — Having a high probability, as shown by statistical procedures, of being due to the operation of factors other than chance

Subsystem Goals — The goals, relating to the subsystems of a system, which are descriptive and qualitative in nature

System — An operational configuration involving interlocking and interdependent instructional techniques and materials presented in a functionally related learning environment in order to achieve specific educational objectives

Taxonomy — Orderly classification

Validity — The accuracy with which any statistic, test, or other measuring device measures what it purports to measure; the extent to which the scores obtained from a test or measuring scale can be used for prediction

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